ZEXEL

FOREWORD

This service manual has been prepared to help service personnel provide quick, effective service and maintenance of the RLD mechanical governor for the diesel engine. The manual explains governor construction and operation, and describes disassembly, reassembly and adjustment procedures. Illustrations, drawings and specifications in this manual are the latest available at the time of publication.

Governor specifications and service procedures are subject to change without notice.

FEATURES

The RLD mechanical governor developed by ZEXEL for automotive diesel engines offers the following features:

1. The governor is of the variable-speed design with a decreased operating force acting on its control lever. The new linkage frees the control lever from the large force applied by a governor spring. The result is a maximum reduction in control lever operating force to a force now equal to that of the minimum-maximum speed governor.

2. Not only can the fuel injection/quantity characteristics necessary for full-load engine operation be controlled, but the excess fuel injection quantity can be set as required for engine starting by simply replacing the torque cam with a more suitable cam. Figures 1 and 2 for example, show how the engine speed response of the governor changes when the torque cam is changed.

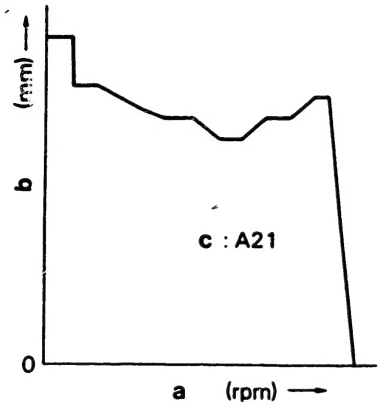


Fig. 1

a = Pump speed (rpm)
b = Control rack position
c = Torque cam

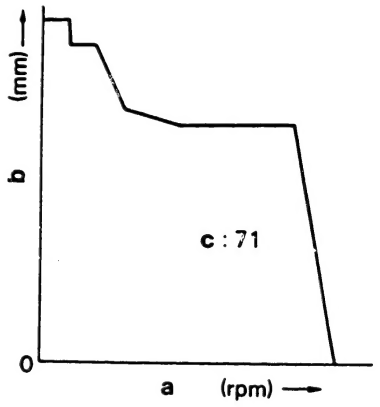


Fig. 2

a = Pump speed (rpm)
b = Control rack position
c = Torque cam

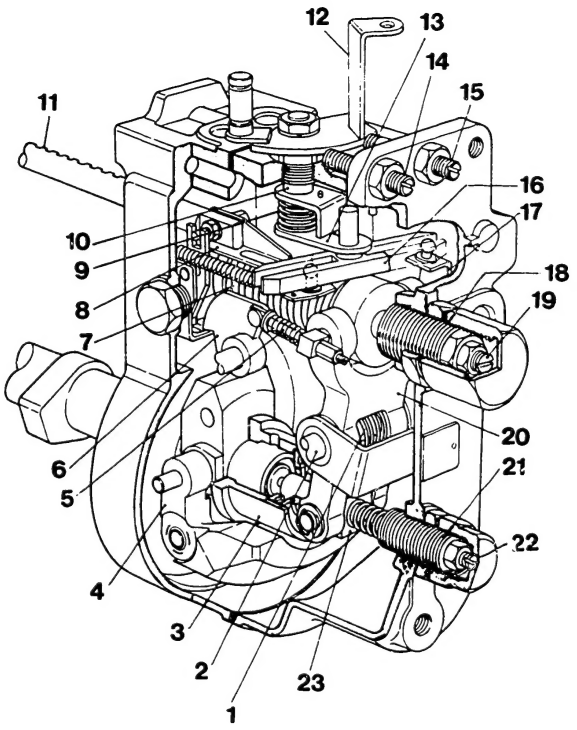


Fig. 3

CONSTRUCTION

1 = Cancel spring (1)
2 = Tension lever shaft
3 = Sleeve
4 = Flyweight
5 = Rod and spring
6 = Torque cam
7 = Governor spring
8 = Rack connecting link
9 = Cancel spring (2)
10 = Control lever shaft
11 = Control rack
12 = Control lever
13 = Supporting lever
14 = Full speed set bolt
15 = Idling set bolt
16 = Floating lever
17 = Guide lever
18 = Guide screw
19 = Governor shaft
20 = Tension lever
21 = Idling spring assembly
22 = Adjusting screw
23 = Shifter

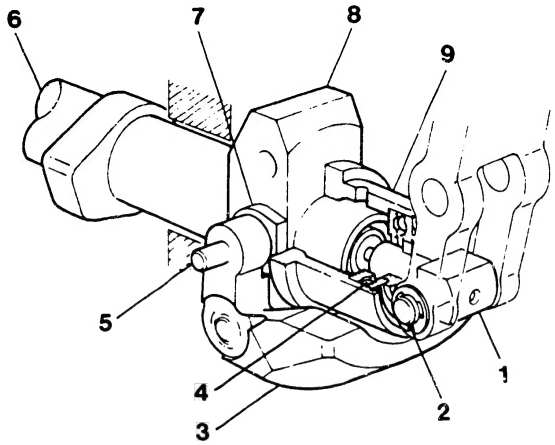


Fig. 4

1 = Shifter
2 = Tension lever pin
3 = Flyweight
4 = Bearing
5 = Pin
6 = Camshaft
7 = Slider
8 = Flyweight holder
9 = Sleeve

Each flyweight is held in place with a pin press-fitted into the flyweight holder, which is then mounted on the fuel injection pump camshaft.

The flyweights open outward, centering on the pins. The opening flyweights cause the sleeve to move in an axial direction along the slider located at the end of the flyweight arm. This sleeve is coupled to the shifter via a bearing. The shifter is joined to the lower end of the tension lever by a pin and moves only in an axial direction. (Fig. 4)

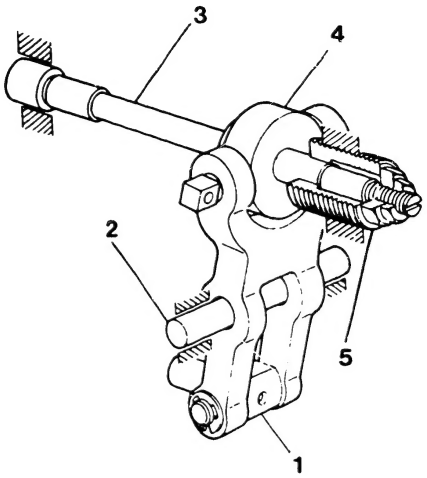


Fig. 5

1 = Shifter
2 = Tension lever shaft
3 = Governor shaft
4 = Spring seat
5 = Guide screw

The tension lever is supported by a tension lever shaft mounted midway to the governor cover. A spring seat is attached to the upper part of the tension lever by a pin, with the governor shaft running through the center hole of the spring seat. The governor shaft is held by a guide screw (locked into the governor cover) and the governor housing; the governor shaft moves only in an axial direction. (Fig. 5)

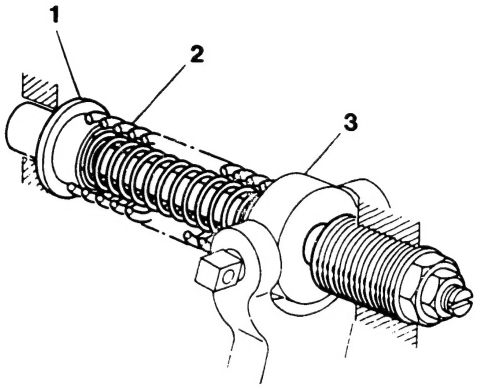


Fig. 6

1 = Spring seat
2 = Governor spring
3 = Spring seat

A spring seat is provided on the drive side of the governor shaft. The governor springs are held uncompressed between the two spring seats.

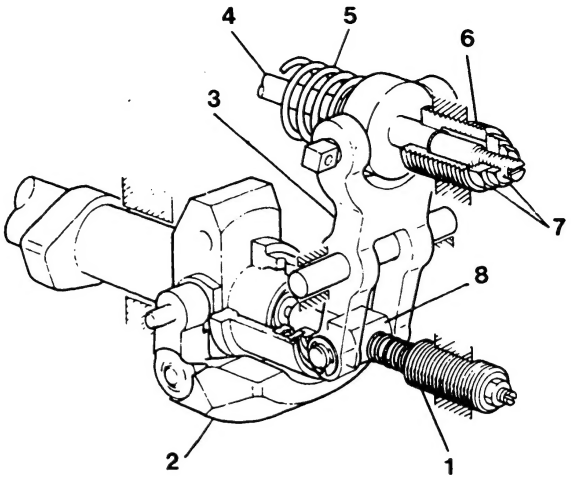


Fig. 7

1 = Idling spring capsule
2 = Flyweight
3 = Tension lever
4 = Governor shaft
5 = Governor spring
6 = Guide screw
7 = Nut
8 = Shifter

The governor-cover end of the governor shaft is threaded and has a nut for setting the position of the drive-side spring seat. Mounted in the lower portion of the governor cover is an idling spring capsule; the idling spring is in contact with the governor-cover end of the shifter.

The governor spring and idling counterbalance the centrifugal force of the flyweights over the entire engine speed range, setting the tension lever in the position appropriate to the flyweight lift. (Fig. 7)

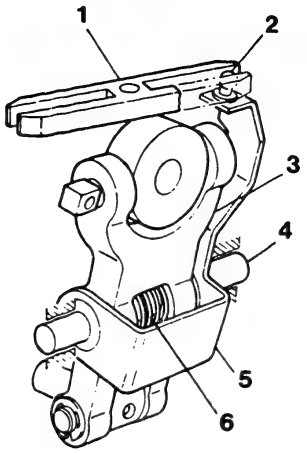


Fig. 8

1 = Floating lever
2 = Ball joint
3 = Tension lever
4 = Tension lever shaft
5 = Guide lever
6 = Cancel spring (1)

The guide lever and the tension lever are mounted concentrically on the tension lever shaft and are held together by the force of cancel spring (1). A ball joint is welded to the top of the guide lever.

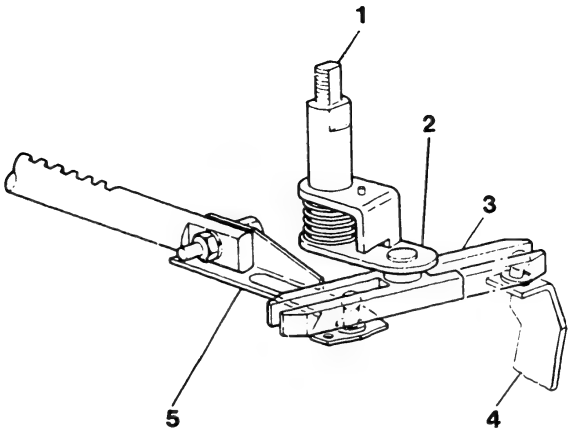


Fig. 9

1 = Control lever shaft
2 = Supporting lever
3 = Floating lever
4 = Guide lever
5 = Rack connecting link

The floating lever is held centrally by a supporting lever. Both ends of the floating lever are fork-shaped with one end engaging the ball joint of the guide lever and the other engaging the ball joint of the rack connecting link, which is attached to the control rack.

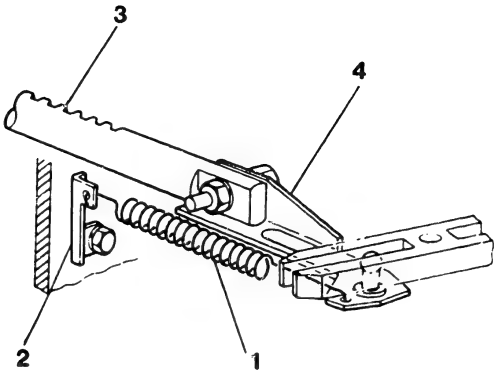


Fig. 10

1 = Start spring
2 = Spring eye
3 = Control rack
4 = Rack connecting link

One end of the start spring is hooked into the spring eye mounted on the governor housing, and the other end is hooked into the rack connecting link. The start spring always works to pull the control rack in the "fuel increase direction."

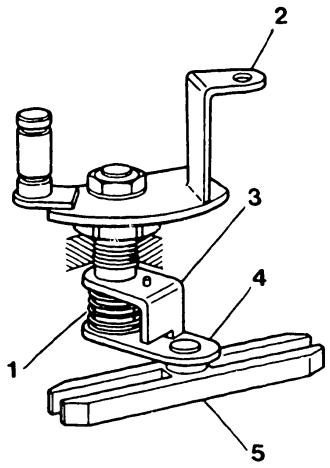


Fig. 11

1 = Cancel spring (2)
2 = Control lever
3 = L type lever
4 = Supporting lever
5 = Floating lever

The control lever shaft is supported by the supporting lever, and is held by cancel spring (2). The control lever, supporting lever, and control lever shaft are a complete unit. Operating the control lever will cause the supporting lever to shift the intermediate fulcrum of the floating lever.

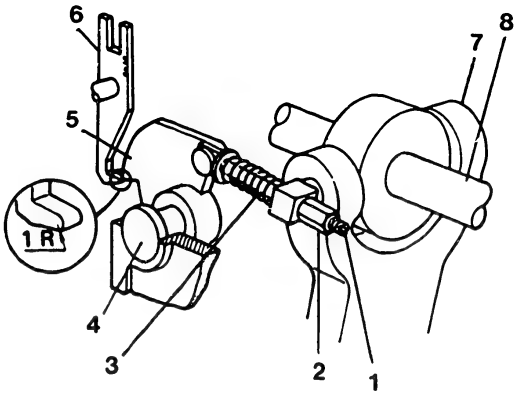


Fig. 12 A view of the torque cam mechanism

1 = Lock screw
2 = Adjusting nut
3 = Rod and spring
4 = Press-fitted pin
5 = Torque cam
6 = Sensor lever
7 = Tension lever
8 = Governor shaft

The torque cam is mounted, as shown in Fig. 12, on a pin press-fitted to the inside of the governor cover (control rack side). This torque cam is connected by a rod and an adjusting nut to the end of the spring seat pin on the upper part of the tension lever.

The distance between the torque cam and tension lever pin is adjusted using the adjusting nut on the threaded end of the rod, and the lock screw. The load on the two springs on the rod can be adjusted using the adjusting nut.
The torque cam pivots on its mounting through either adjustment of the rod, or movement of the tension lever as the flyweight lift changes.

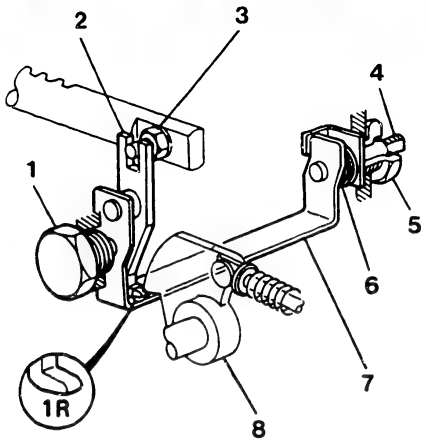


Fig. 13 Sensor lever mechanism

1 = Guide screw
2 = Sensor lever
3 = Ball pin
4 = Full-load setting lever shaft
5 = Bush
6 = Cancel spring (3)
7 = U-shaped lever
8 = Torque cam

A nut and shaft are set into the governor housing on the side opposite to the control rack. Attached to the shaft is a bushing. A U-Shaped lever attached to the sensor lever pin is mounted between the shaft fitted in the bushing and a guide screw, as shown in Fig. 13. The U-Shaped lever, the shaft in the bushing and cancel spring (3) move as one unit.

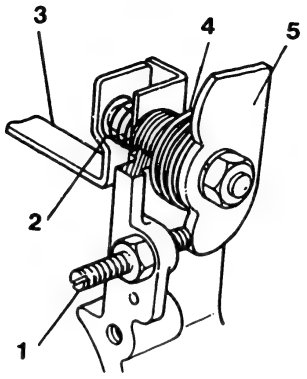


Fig. 14 Full-load setting lever mechanism

1 = Full-load setting bolt
2 = Cancel spring (3)
3 = U-shaped lever
4 = Return spring (3)
5 = Full-load setting lever

The sensor lever is fitted to the U-Shaped lever. The upper end of the sensor lever is fork-shaped and engages a bolt that clamps both the control rack and rack connecting link. The lower end of the sensor lever is in contact with the torque cam. The full-load setting lever and return spring are mounted on the full-load setting lever shaft, as shown in Fig. 14.

The full-load setting lever is always forced against the full-load setting bolt. Movement of the full-load setting lever results in corresponding movement of the sensor lever. There are two adjusting bolts; one for the maximum engine speed and one for idling speed, located at the top of the governor cover.

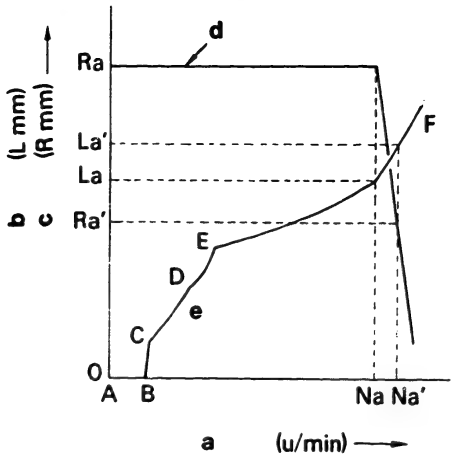


Fig. 15

a = Pump speed (rpm)
b = Flyweight lift
c = Control rack position
d = Transition of control rack position
e = Transition of flyweight lift

PRINCIPLES OF OPERATION

Variable Speed Control

Unlike a conventional variable-speed governor which controls engine speed according to the governor spring force as set by the control lever, the RLD mechanical governor effects engine speed control by setting the floating lever fulcrum with the control lever.

With the RLD governor only a very small force is needed to work the control lever.
Figure 15 shows the relationships between fuel injection pump speed, flyweight lift and control rack position.
Figure 16 shows how the RLD mechanical governor operates.

The idling spring and governor spring of the RLD governor do not provide an initial setting force; when the flyweight lift is 0 as shown in Fig. 15, only the start spring provides the initial setting force. Therefore, flyweight lift begins at a speed greater than the pump speed (B), which produces the centrifugal force necessary to overcome the initial setting force of the start spring. As engine speed increases, the flyweight's centrifugal force exceeds the setting forces of the idling and governor springs (Fig. 15 B to F); the maximum lift of the flyweight is 13 mm. Flyweight lift results in movement of the tension lever by way of the shifter, with guide lever movement following. Guide lever movement results in movement of the floating lever, which then moves the control rack in the opposite direction.

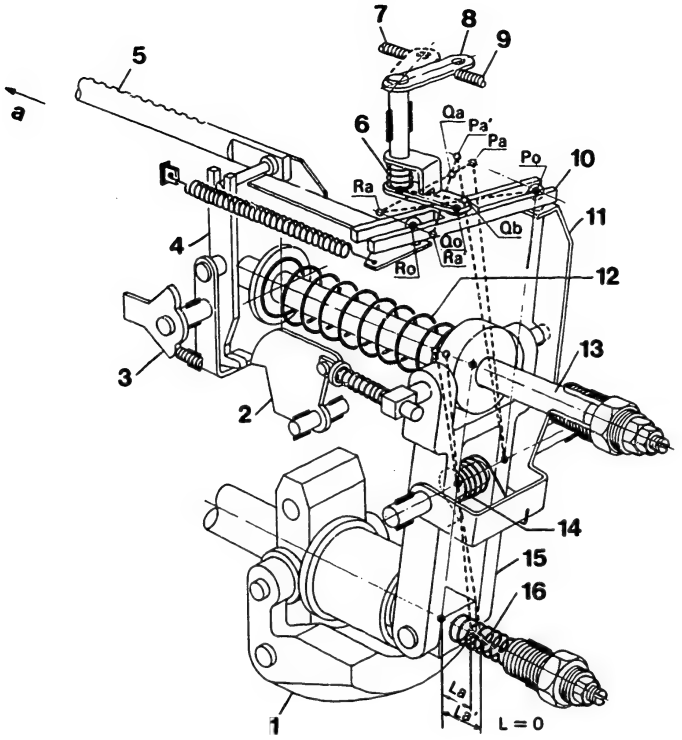


Figure 16

1 = Flyweight
2 = Torque cam
3 = Full-load setting lever
4 = Sensor lever
5 = Control rack
6 = Cancel spring (2)
7 = Maximum-speed setting bolt
8 = Control lever
9 = Idling speed setting bolt
10 = Floating lever
11 = Guide lever
12 = Governor spring
13 = Governor shaft
14 = Cancel spring (1)
15 = Tension lever
16 = Idling spring

a = Fuel increase direction

Point P: Guide lever side
Ball joint fulcrum
Point Q: Floating lever fulcrum
Point R: Rack connecting link fulcrum

Moving the control lever slightly from the idling position toward the full-speed setting bolt, with the guide lever-side ball joint held at Po when the fuel injection pump is not operating (shown by the solid line in Fig. 16), will cause the supporting lever to pivot the floating lever at point Po

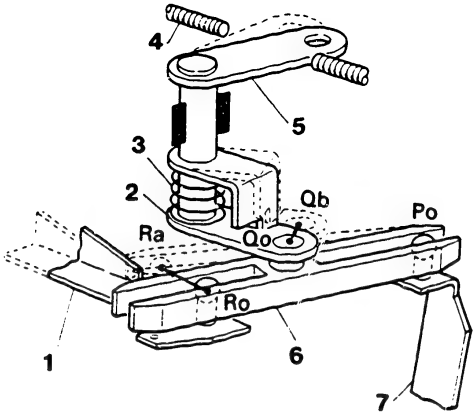


Fig. 17

1 = Rack connecting link
2 = Supporting lever
3 = Cancel spring (2)
4 = Maximum-speed setting bolt
5 = Control lever
6 = Floating lever
7 = Guide lever

As the floating lever pivots, the control rack moves from Ro to increase the fuel injection quantity. After the control rack reaches the Ra rack position, two fulcrums (Po and Ra) are fixed. The floating lever fulcrum is fixed at point Qb on the line extending between floating lever fulcrums Po and Ra (Fig. 17).

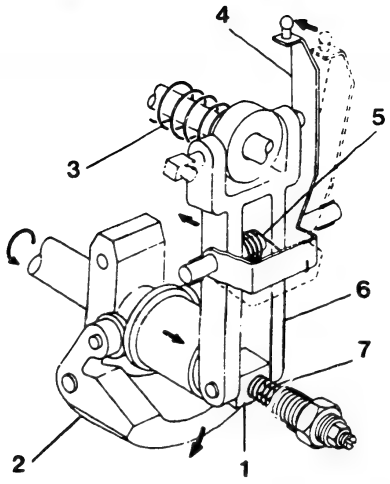


Fig. 18

1 = Shifter
2 = Flyweight
3 = Governor spring
4 = Guide lever
5 = Cancel spring (1)
6 = Tension lever
7 = Idling spring

Moving the control lever further toward the full-speed setting bolt will move the L-Shaped lever from the supporting lever.

If the engine is started under this condition, the fuel injection pump speed increases, with the flyweight' s centrifugal force finally increasing beyond the sum of the idling spring and governor spring forces. The flyweight moves the guide lever via the tension lever. (Fig. 18)

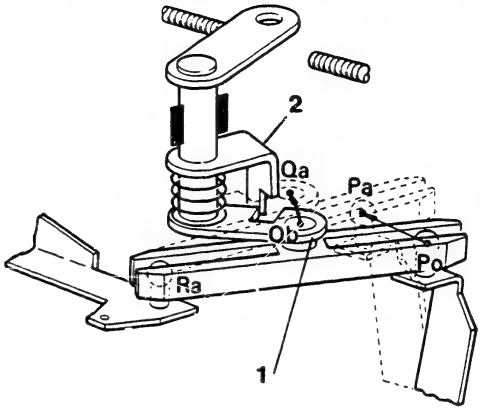


Fig. 19

1 = Supporting lever
2 = L-Shaped lever

Flyweight lift causes the tension lever and guide lever to move, advancing the ball joint from Po to Pa as engine speed increases. The floating lever movement coincides with the turning of the supporting lever around Ra of the control rack side ball joint, with the force of the cancel spring (2) applied to the supporting lever. The fulcrum of the floating lever thus shifts to Qb.

Pump speed reaches Na when the guide lever ball joint reaches Pa. Simultaneously, the fulcrum of the floating lever shifts to Qa where the L-Shaped lever and supporting lever contact (Fig. 19).

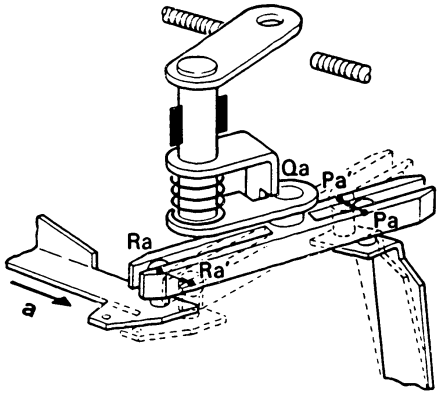


Fig. 20

a = Fuel decrease direction

When the engine speed exceeds Na', the fly-weight lift reaches La', and Pa (the guide-lever ball joint) shifts to Pa'. At this time, the floating lever pivots at Qa while the control rack moves from Ra toward Ra' to decrease the fuel injection quantity (Fig. 20).

The governor controls engine speed by moving the control rack to increase the fuel injection quantity (while keeping the floating lever fulcrum at a variable point) as engine speed increases from the value at which pump speed Na is in equilibrium with Ra (the control rack position).

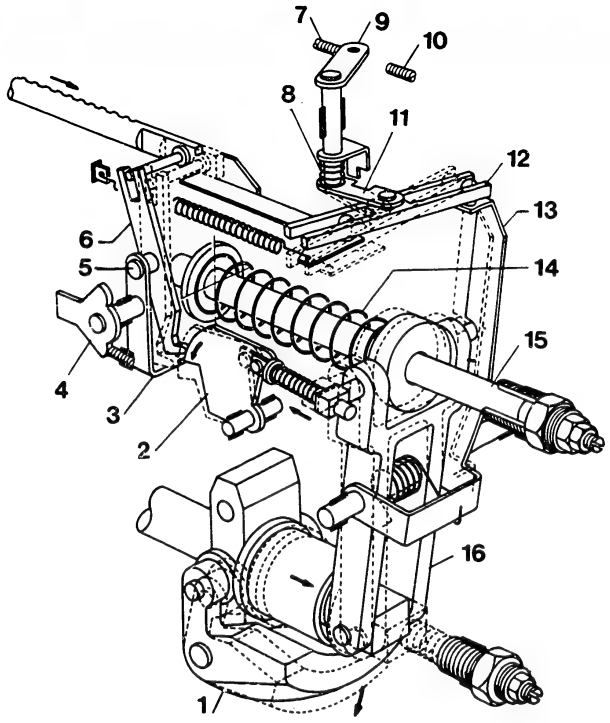


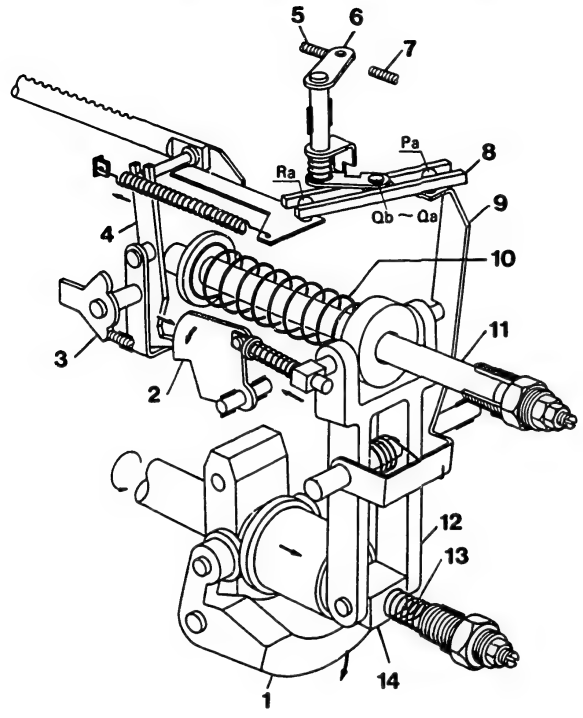
Fig. 21

Full-load control rack position: torque cam regulation

1 = Flyweight
2 = Torque cam
3 = U-Shaped lever
4 = Full-load setting lever
5 = S fulcrum
6 = Sensor lever
7 = Maximum-speed setting bolt
8 = Cancel spring (2)
9 = Control lever
10 = Idling speed setting bolt
11 = Supporting lever
12 = Floating lever
13 = Guide lever
14 = Governor spring
15 = Governor shaft
16 = Tension lever

The torque cam allows the full-load control rack position to be altered to increase or decrease the fuel injection quantity according to the pump speed, which changes with engine speed. The torque cam was developed to lessen the exhaust emission and to increase the maximum torque response and maximum output response of the engine at full load. Moving the control lever so that it contacts the full-speed setting bolt while the engine is exceeding idling speed will alter the fuel injection quantity. Simultaneously, the sensor lever turns around S, the fulcrum of the U-Shaped lever, with the lowermost part of the sensor lever in contact with the torque cam. The result is that the control rack movement is regulated as illustrated by the solid line in Fig. 21.

Under the conditions specified above, cancel spring (2) causes the control rack side ball joint to pivot the floating lever with the guide lever ball joint serving as a fulcrum.



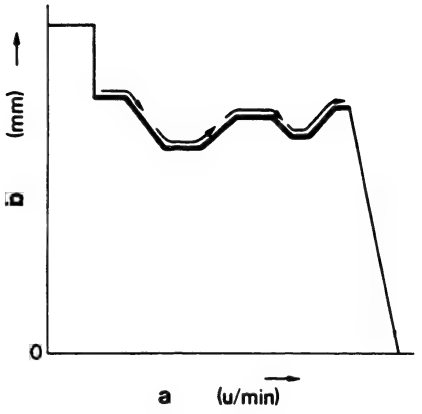


Figure 22

1 = Flyweight
2 = Torque cam
3 = Full-load setting lever
4 = Sensor lever
5 = Maximum-speed setting bolt
6 = Control lever
7 = Idling speed setting bolt
8 = Floating lever
9 = Guide lever
10 = Governor spring
11 = Governor shaft
12 = Tension lever
13 = Idling spring
14 = Shifter

a = Pump speed (rpm)
b = Control rack position

Consequently, the sensor lever contacts the torque cam. Then, as the pump speed gradually increases, the tension lever turns the torque cam counter-clockwise (Fig. 22) via the rod at the top of the tension lever. The position of the torque cam is dependant on engine speed. The sensor lever is in contact with the torque cam, regulating the full-load control rack position. This torque cam mechanism can be used in a variety of engines, since the profile of the torque cam can be specifically designed to satisfy the full-load fuel injection quantity requirements of individual engines.

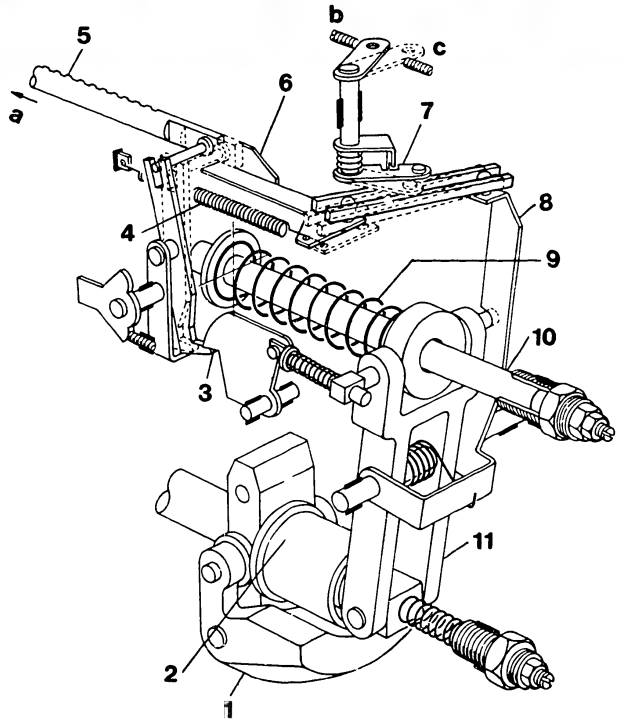


Fig. 23

Starting fuel injection quantity: increase mechanism

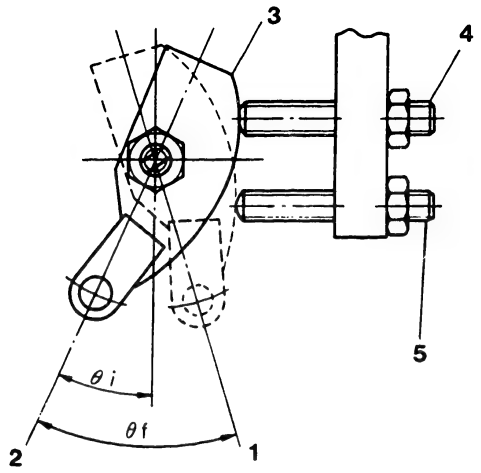
1 = Flyweight
2 = Sleeve
3 = Torque cam notch
4 = Start spring
5 = Control rack
6 = Rack connecting link
7 = Supporting lever
8 = Guide lever
9 = Governor spring
10 = Governor shaft
11 = Tension lever

a = Fuel increase direction
b = Maximum-speed position
c = Idling position

When the engine is not running, the start spring, through the floating and guide levers, acts on the tension lever to minimize the flyweight lift and turn the torque cam clockwise. Moving the control lever when both the tension lever and the torque cam are as described above, from the idling position (dotted line) to the full-speed position (solid line) will, via the supporting lever move the control rack to increase the fuel injection quantity. At this time, the lower edge of the sensor lever contacts the notch in the torque cam, tracing the path indicated by the solid line in Fig. 23. As a result, the full-load control rack position is shifted to the fuel injection quantity increase position.

Turning the control lever back to the idling position after the engine starts will cause the floating lever to pull the control rack back, disengaging the sensor lever from the notch in the torque cam.

Caution: **Do not rev up the engine after it starts. To do so will prevent the sensor lever disengaging from the notch of the torque cam and will interfere dangerously with governor control.**



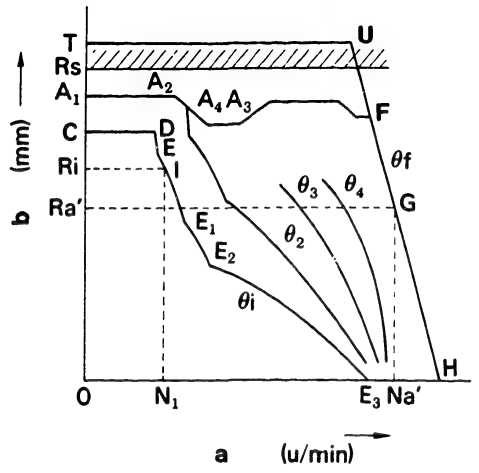


Fig. 24 A performance diagram of the RLD mechanical governor

1 = Full-speed
2 = Idling
3 = Control lever
4 = Idling speed setting bolt
5 = Full-load setting bolt

a = Pump speed (rpm)
b = Control rack position

Figure 24 is a performance diagram of the RLD mechanical governor, with the control lever set at position θ.

1. Idling lever set position (θi).

C-D: The setting force of the start spring, exceeding the flyweight's centrifugal force (flyweight lift 0).

D-E: The start spring force yielding to the flyweight's centrifugal force, and moving the control rack.

E-E_1: Range of engine speed control by the idling spring; I is the idling point.

E-E_3: Range of engine speed control by both the idling spring and governor spring.

θ_2, θ_3, and θ_4 are performance curves obtained with the control lever positioned at three different points. The closer the control lever is to the full-speed side, the shallower the performance curve.

2. Maximum-speed set position of lever. (θf)

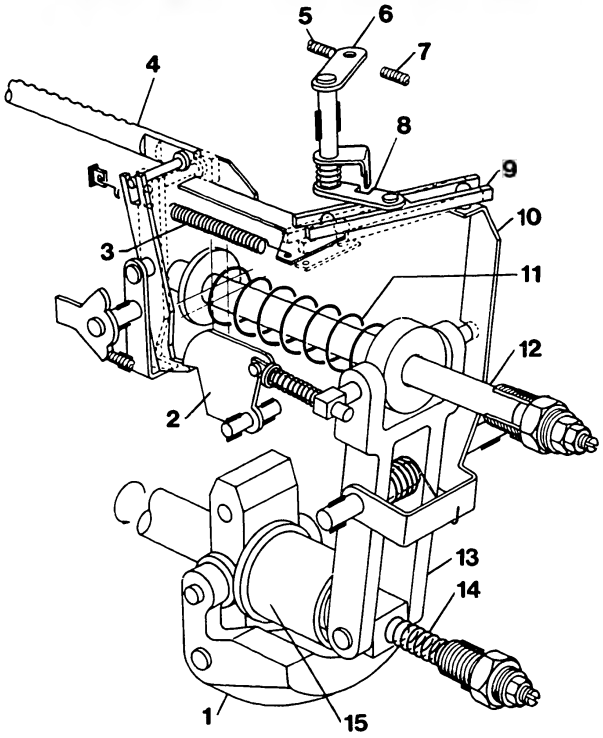
A_1-A_2-F: Range of engine speed control by the torque cam.

F-G-H: Range of engine speed control by the governor spring. The point G is a state of no-load maximum speed.

3. Increase of starting fuel injection quantity.

When engine speed is increased after setting the control lever to the maximum-speed position while the engine was stationary;

T-U: Represents the range of the engine's starting fuel injection quantity, which is available when the sensor lever is engaged in the torque cam notch. Normally however, the control rack is maintained at Rs by the rack limiter.



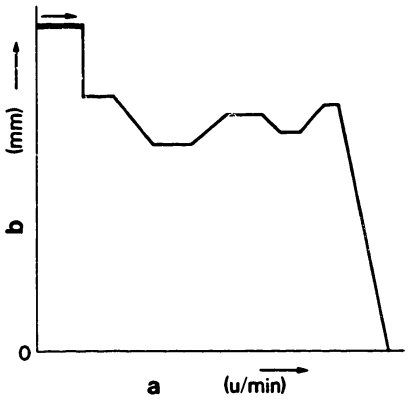


Fig. 25

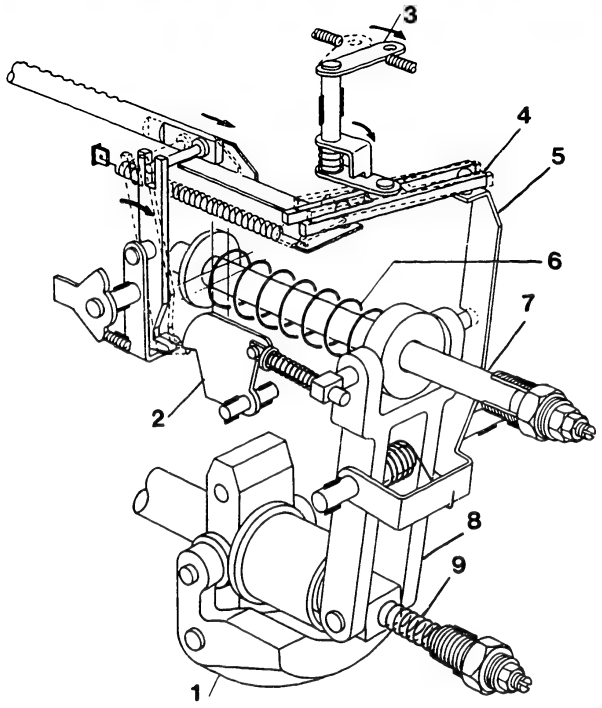
1 = Flyweight
2 = Torque cam
3 = Start spring
4 = Control rack
5 = Maximum-speed setting bolt
6 = Control lever
7 = Idling speed setting bolt
8 = Supporting lever
9 = Floating lever
10 = Guide lever
11 = Governor spring
12 = Governor shaft
13 = Tension lever
14 = Idling spring
15 = Sleeve

a = Pump speed (rpm)
b = Control rack position

OPERATION

The flyweights are kept closed while the engine is not running. As explained previously, both the idling spring and governor spring are normally not compressed, with no initial set force.
When the operator depresses the accelerator fully, the control lever linked to the accelerator rod contacts the maximum-speed setting bolt. Simultaneously, the floating lever also moves, pushing the control rack to increase the engine's starting fuel injection quantity.

The sensor lever engages the notch of the torque cam, which controls the engine's starting fuel injection quantity. The control rack then moves beyond the full-load rack position and finally reaches the starting fuel injection quantity increase position, which is set by the rack limiter. (Fig. 25)



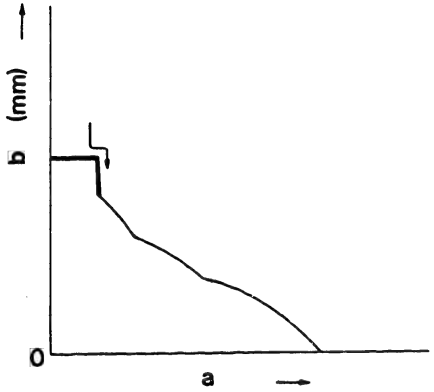


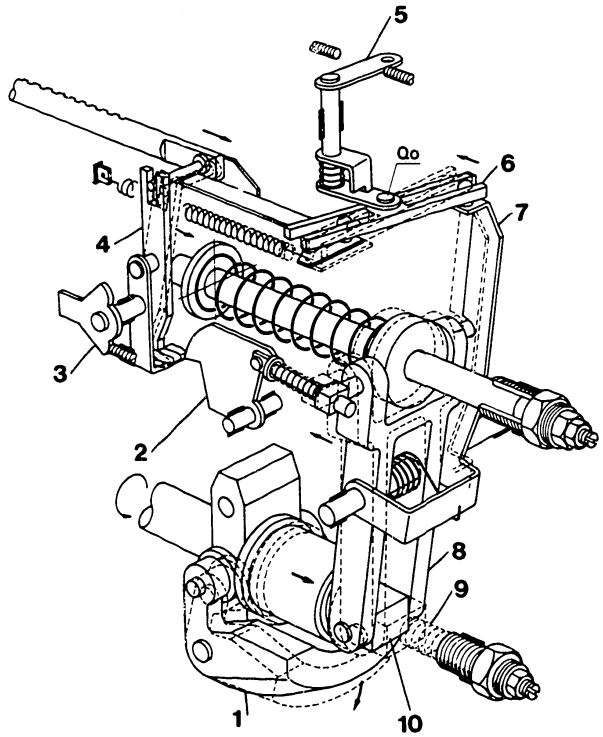
Figure 26

1 = Flyweight
2 = Torque cam
3 = Control lever
4 = Floating lever
5 = Guide lever
6 = Governor spring
7 = Governor shaft
8 = Tension lever
9 = Idling spring

a = Pump speed (rpm)
b = Control rack position

When the accelerator is released after engine starting, the control lever returns to contact the idling speed setting bolt.

Next, the control rack moves to decrease the fuel injection quantity and the sensor lever edge is released from the torque cam notch. Working the control lever thereafter does not increase the engine's starting fuel injection quantity. (Fig. 26)



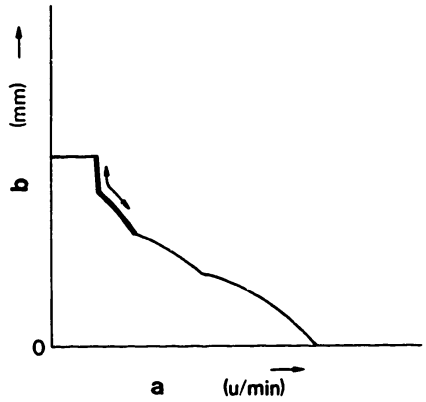


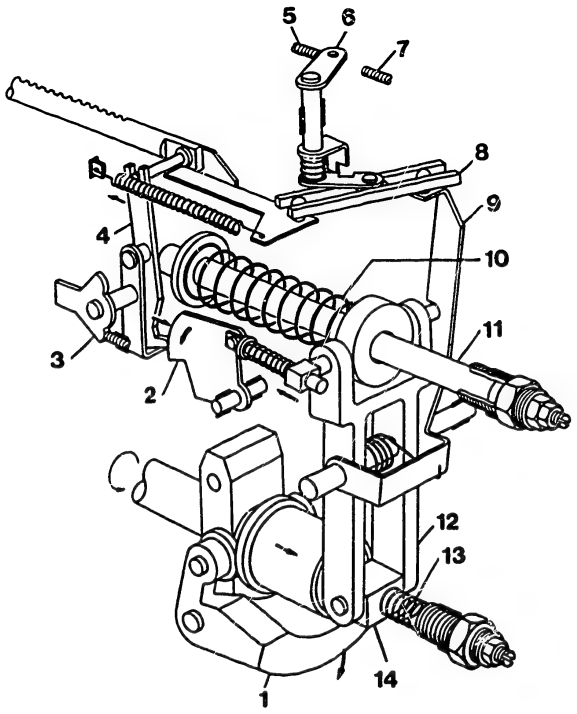
Fig. 27 Idling speed control

1 = Flyweight
2 = Torque cam
3 = Full-load setting lever
4 = Sensor lever
5 = Control lever
6 = Floating lever
7 = Guide lever
8 = Tension lever
9 = Idling spring
10 = Shifter

a = Pump speed (rpm)
b = Control rack position

When the control lever returns to the idling position after the engine starts, the floating lever fulcrum returns to idling position Qo, ready for the governor to begin idling speed control. When engine speed decreases the flyweight's centrifugal force also decreases, yielding to the idling spring force and the flyweights close. The control rack then moves about floating lever fulcrum Qo in the increase fuel injection quantity direction to prevent engine stalling. If engine speed increases, the idling spring force then becomes less than flyweight's centrifugal force, thus pulling back the control rack to decrease the fuel injection quantity, (as shown by the dotted line in Fig. 27) and thus decreasing the engine speed.
In this way the governor stabilizes engine idling, using the balance between the flyweight's centrifugal force and the sum of the start spring and idling spring forces to compensate for engine speed fluctuations.

While the engine is idling, the sensor lever does not make contact with the torque cam



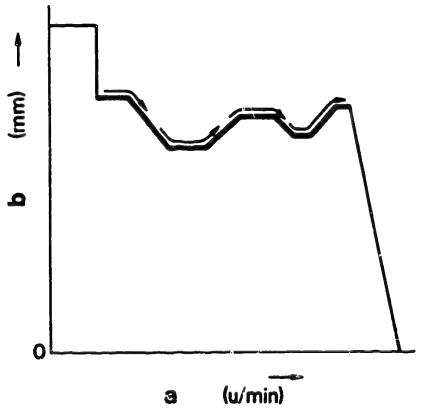


Fig. 28

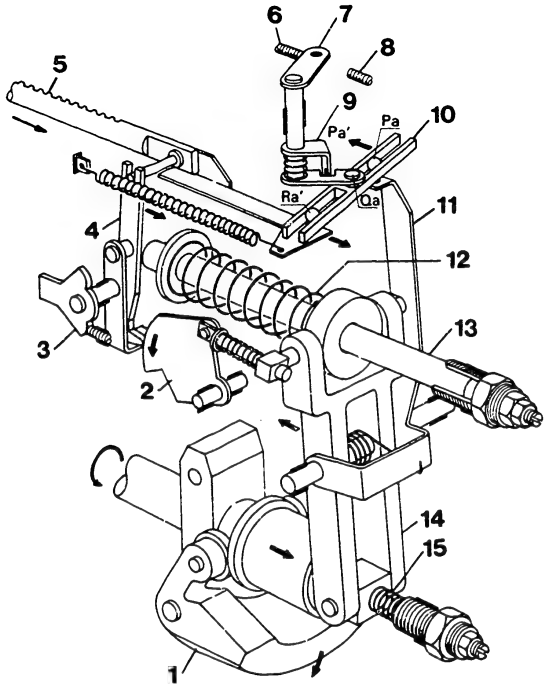
Torque cam control of fuel injection quantity during full-load

1 = Flyweight
2 = Torque cam
3 = Full-load setting lever
4 = Sensor lever
5 = Maximum-speed setting bolt
6 = Control lever
7 = Idling speed setting bolt
8 = Floating lever
9 = Guide lever
10 = Governor spring
11 = Governor shaft
12 = Tension lever
13 = Idling spring
14 = Shifter

a = Pump speed (rpm)
b = Control rack position

Depressing the accelerator while the engine is running under load, until the control lever contacts the maximum-speed setting bolt, will move the floating lever around the ball joint of the guide lever, and moving the control rack forward to the full-load position (Ra) will move the sensor lever edge to contact the torque cam. Engine speed fluctuations thereafter will pivot the tension lever around the tension lever shaft.

Similarly, the torque cam moves around its shaft. As the torque cam moves, the sensor lever edge follows the surface of the torque cam, shifting the control rack position to control the fuel injection quantity. When engine speed changes, the tension lever pivots, shifting the ball joint at Pa on the guide lever and moving the floating lever fulcrum Q. Torque cam movement shifts the control rack by way of the sensor lever.



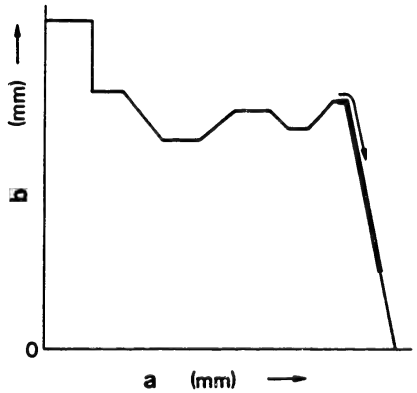


Fig. 29

Maximum speed control

1 = Flyweight
2 = Torque cam
3 = Full-load setting lever
4 = Sensor lever
5 = Control rack
6 = Maximum-speed setting bolt
7 = Control lever
8 = Idling speed setting bolt
9 = (L-shaped lever)
10 = Floating lever
11 = Guide lever
12 = Governor spring
13 = Governor shaft
14 = Tension lever
15 = Idling spring

a = Pump speed (rpm)
b = Control rack position

With the control lever in contact with the maximum-speed setting bolt, engine speed can increase while the fuel injection quantity is controlled by the torque cam-sensor lever mechanism.
When engine speed increases further, with the supporting lever in contact with the L-Shaped lever on the control lever shaft, the guide lever ball joint moves from Pa toward Pa' around floating lever fulcrum Qa. The control rack is then pulled back to decrease the fuel injection quantity for maximum speed governing. Meanwhile, the sensor lever edge disengages from the torque cam for maximum-speed control.

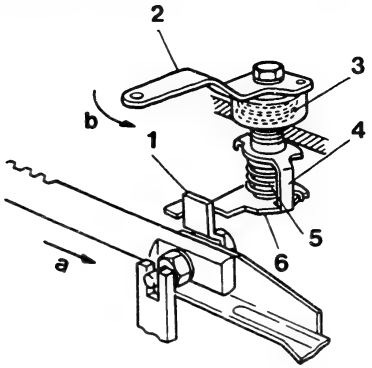


Fig. 30

1 = Stopping device plate
2 = Stop lever
3 = Return spring
4 = Supporting lever
5 = Cancel spring
6 = Stopping device lever

a = Fuel decrease direction
b = Stopping direction

ATTACHMENTS

Stopping Device

Construction

Like other governors, the RLD mechanical governor can be equipped with a stopping device. The stopping device is mounted on the top of the governor housing, as shown in Fig. 30.

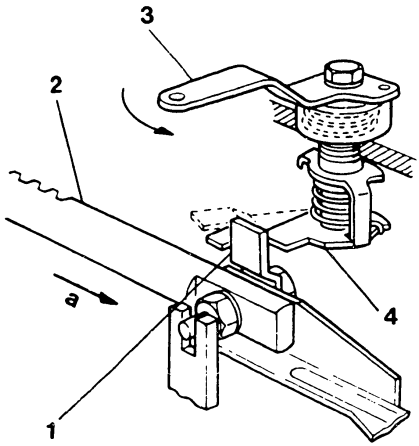


Fig. 31

1 = Stopping device plate
2 = Control rack
3 = Stop lever
4 = Stopping device lever
a = Fuel decrease direction

Operation

The stopping device lever cannot contact the stopping device plate when the stop lever is disengaged (the stop lever is held in the normal position by a return spring). Turning the stop lever toward the stop side when the engine is idling will cause the stopping device lever to move the stopping device plate, which will move the control rack to the non-injection position and shut down the engine. (Fig. 31)

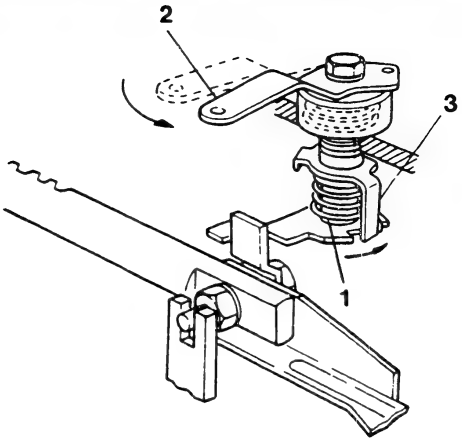


Fig. 32

1 = Cancel spring
2 = Stop lever
3 = Supporting lever

Even if the stopping device is mistakenly operated while the vehicle is running, the engine will not stop. The reason for this is that because the cancel spring force is less than the governor springs' set force, it cannot move the control rack to the non-injection position (Fig. 32). Because of this, although the working range of this stopping device lever is approximately 40°, the effective range is only approx. 30° from the normal position.

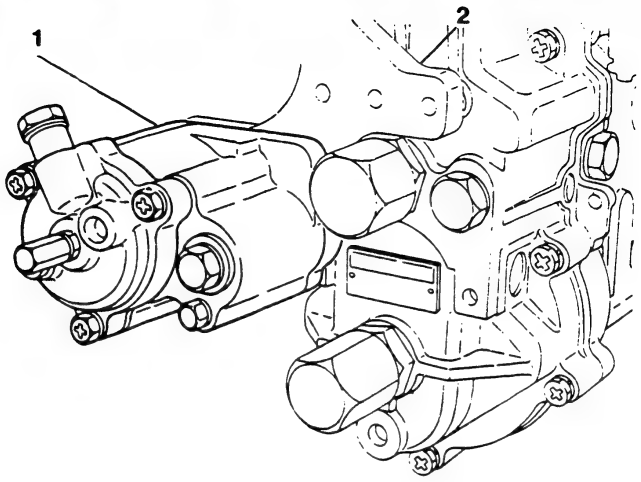


Fig. 33 Installation position of boost compensator

1 = Boost compensator
2 = Spacer

Boost Compensator

Construction

Fig. 33 shows the installation position of the boost compensator on the governor. The spacer is used to fix the boost compensator in position, and is attached to the end face of the governor cover using 3 bolts.

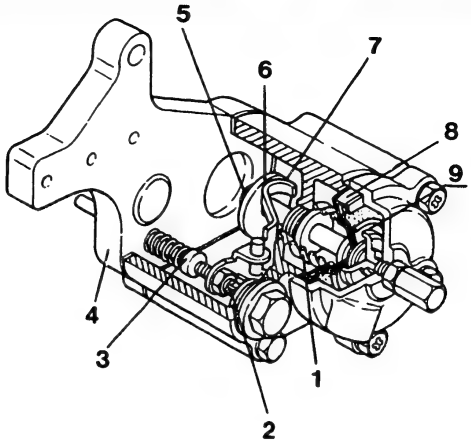


Fig. 34 Cross-sectional view of boost compensator

1 = Boost control spring
2 = Set screw
3 = Pushrod B
4 = Spacer
5 = Pushrod A
6 = Disc
7 = Lever
8 = Diaphragm
9 = Boosting chamber

Fig. 34 shows a cross-sectional view of the boost compensator.

The boost control spring in the atmospheric chamber is always acting against the pressure of the compressed air supplied to the boosting chamber from the turbo charger.
Pushrod A fixed to the diaphragm contacts the control rack via the set screw, pushrod B and the U-shaped lever.

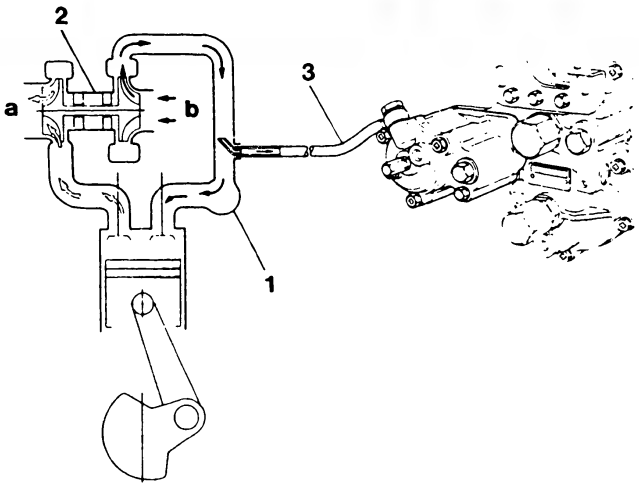


Fig. 35

1 = Inlet manifold
2 = Turbo charger
3 = Pipe

a = Exhaust
b = Suction

Operation

As engine speed increases, the turbocharger begins to deliver compressed air to the boosting chamber of the boost compensator. (Fig. 35)

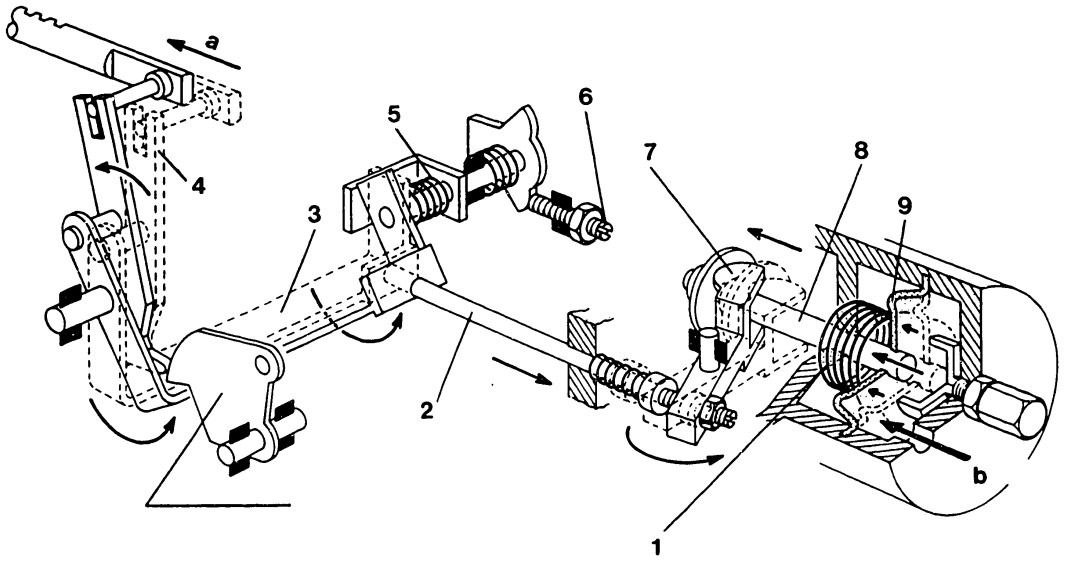


Figure 35

1 = Boost compensator spring
2 = Pushrod B
3 = U-shaped lever
4 = Sensor lever
5 = Cancel spring
6 = Full-load setting screw
7 = Lever
8 = Pushrod A
9 = Diaphragm

a = Fuel increase direction
b = Compressed air

When the pressure of compressed air exceeds the setting force of the boost compensator spring, the diaphragm and pushrod A move toward the drive side.

Movement of pushrod A moves the lever counterclockwise, moving pushrod B in a direction away from the drive side, and following the lever movement. The U-shaped lever is then turned counterclockwise by a cancel spring. The U-shaped lever thus follows the movement of pushrod B.

The result is that the center fulcrum of the sensor lever moves counterclockwise, causing the sensor lever to move the control rack toward the drive side (fuel increase direction), since the sensor lever edge is in contact with the torque cam. (Fig. 36)
Boost compensator stroke is adjusted through a set spring and setting screw attached to pushrod B.

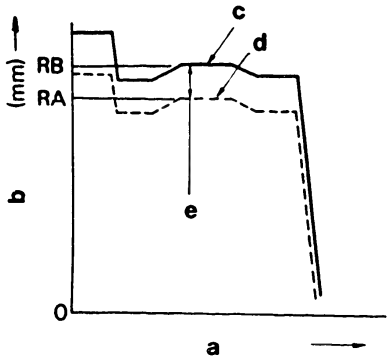


Fig. 37 Governor performance line drawing

a = Pump speed (rpm)
b = Control rack position
c = Boost compensator operating
d = Boost compensator not operating
e = Boost compensator stroke

The governing characteristics of the boost compensator-equipped fuel injection pump are shown in Fig. 37. At specified maximum boost compensator pressure the fuel injection quantity is increased an amount corresponding to control rack position RB-RA (i.e. boost compensator stroke.)

This increase is in addition to full-load fuel injection quantity.

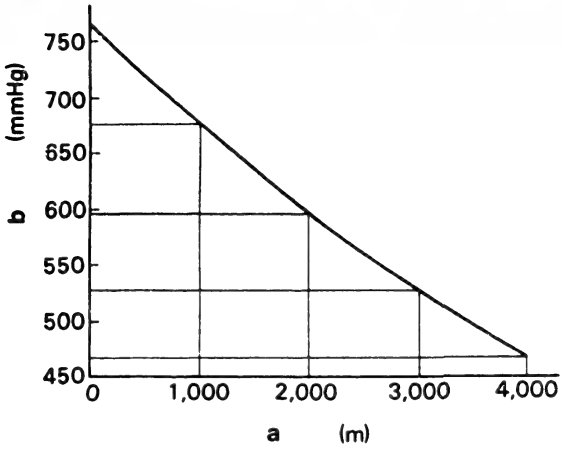


Fig. 38 Relationship between atmospheric pressure and altitude

a = Altitude
b = Atmospheric pressure

Aneroid Compensator

Purpose

Fig. 38 shows the relationship between atmospheric pressure and altitude. Atmospheric pressure decreases as altitude increases.

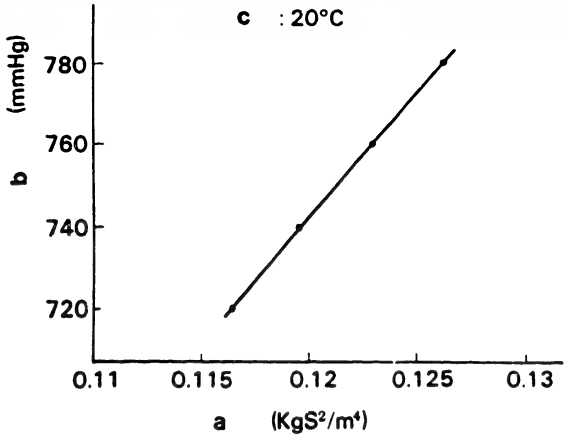


Fig. 39 Dry air density

a = Density
b = Atmospheric pressure
c = Air temperature

Fig. 39 shows the relationship between atmospheric pressure and air density. Air density decreases as the atmospheric pressure decreases.

As mentioned previously, a vehicle with a diesel engine adjusted to function at low altitudes may experience the following problems due to excessive fuel injection when used at high altitudes.

1. Increased emission of black smoke.
2. Insufficient engine output, despite increased fuel consumption.
3. Carbon deposits in the combustion chamber (thus shortening the service life of the engine).

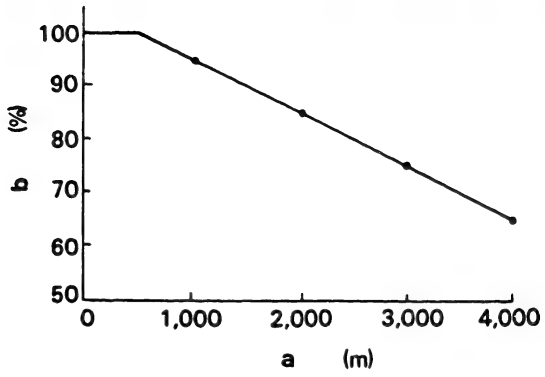


Fig. 40

a = Altitude
b = Full-load injection quantity

In order to prevent the above problems, the full-load fuel injection quantity must be adjusted to compensate for altitude, as shown in Fig. 40.

The aneroid compensator moves the U-shaped lever via the pushrod as the atmospheric pressure changes, allowing the control rack to alter the full-load injection quantity.

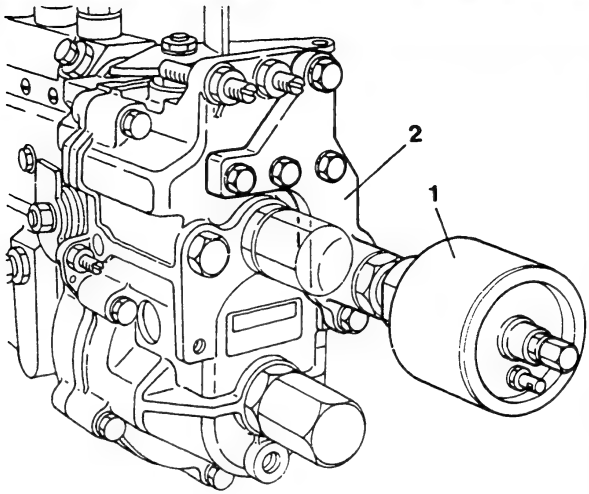


Fig. 41 Installation position of aneroid compensator

1 = Housing
2 = Spacer

Construction of the standard-type aneroid compensator

Fig. 41 shows the installation position of the aneroid compensator on the governor. The aneroid compensator consists basically of a spacer and housing. The spacer is used to fix the housing in position, and is attached to the end face of the governor cover using 5 bolts. The housing (aneroid compensator body) is screwed into the spacer and held in position with a locknut.

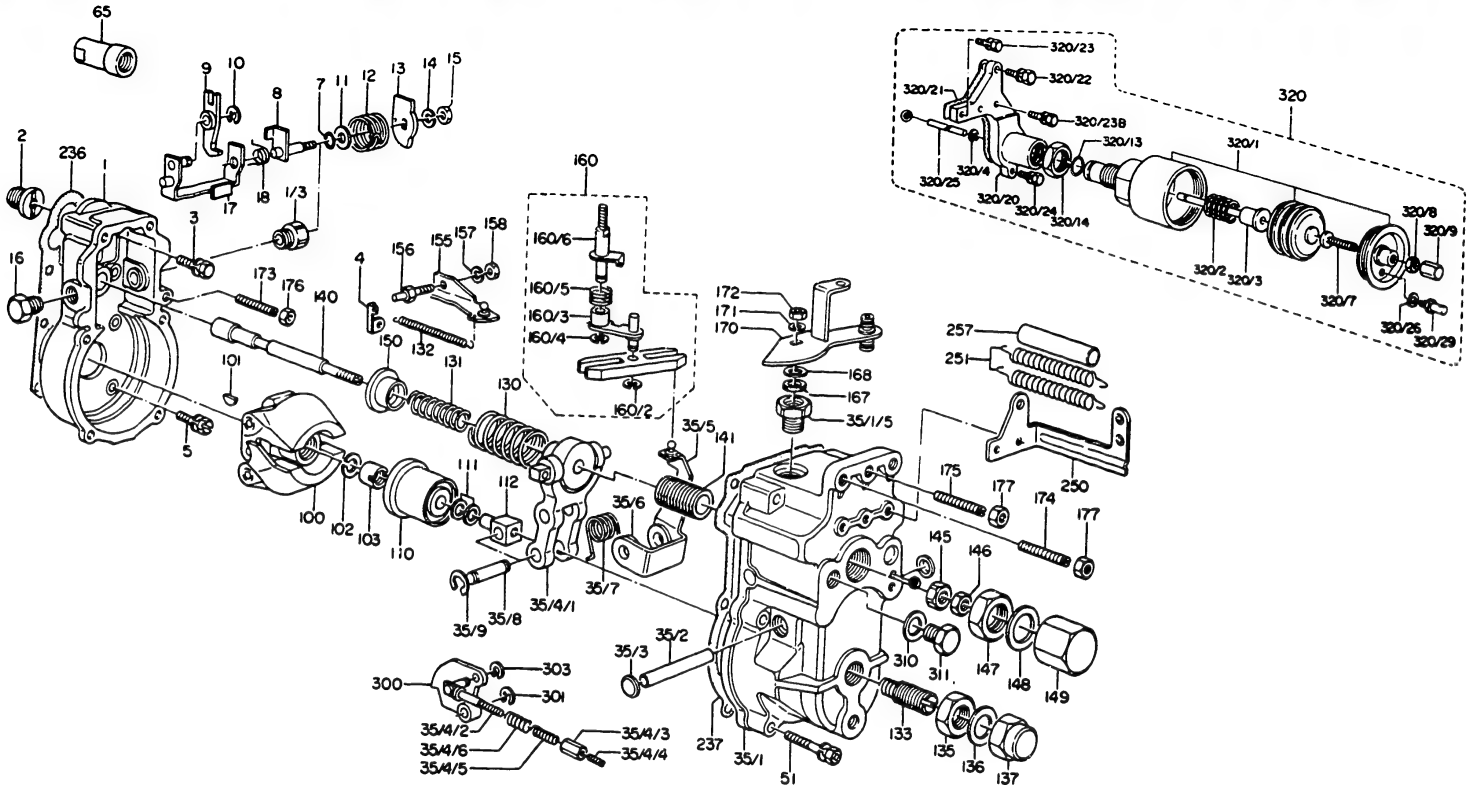


Fig. 42 Exploded view of the standard type aneroid compensator-equipped RLD-A governor

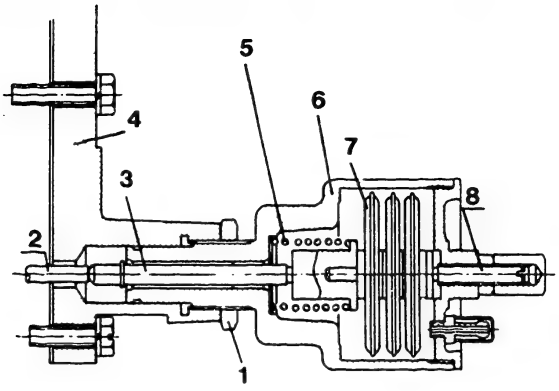


Fig. 43 Cross-sectional view of aneroid compensator

1 = Locknut
2 = Pushrod (2)
3 = Pushrod (1)
4 = Spacer
5 = Aneroid compensator spring
6 = Housing
7 = Bellows
8 = Set screw

Fig. 43 shows a cross-sectional view of the aneroid compensator.

The inside of the aneroid compensator housing is at atmospheric pressure.
The housing consists of the following main parts:

set screw, bellows, aneroid compensator spring, pushrod (1) and pushrod (2) (which is assembled inside the governor).
The bellows is attached to pushrod (1), and is held against the set screw by the set force of the aneroid compensator spring. Pushrod (2) is installed inside the governor. One end contacts the plate of the U-shaped lever, and the other end contacts pushrod (1).

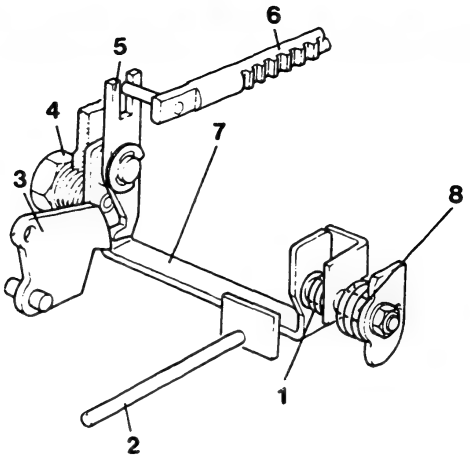


Fig. 44 Internal construction of the governor

1 = Cancel spring
2 = Pushrod (2)
3 = Torque cam
4 = Guide screw
5 = Sensor lever
6 = Control rack
7 = U-shaped lever
8 = Load control lever shaft

Fig. 44 shows a partial view of the internal construction of the governor. The U-shaped lever which contacts pushrod (2) is supported by the load control lever shaft and the guide screw installed in the outside face of the governor, and can move freely.

A cancel spring is assembled with the load control lever shaft and is set in the clockwise rotation direction, so as to always act to increase the fuel injection quantity.

The sensor lever uses the U-shaped lever as a pivot, and can pivot freely. The lower end contacts the torque cam, which governs engine performance, and the upper end is connected to the control rack.

Therefore, the sensor lever transmits torque cam movement and U-shaped lever movement to the control rack to control the fuel injection quantity.

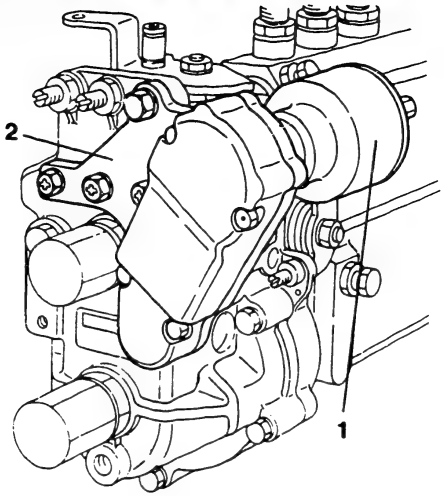


Fig. 45 Installation position of "inverted-type" aneroid compensator

1 = Housing
2 = Spacer

Construction of the "inverted-type" aneroid compensator

Fig. 45 shows the installation position of the "inverted-type" aneroid compensator on the governor. As there are problems mounting the injection pump assembly on some engines, this type of aneroid compensator is used. The housing is attached to the side of the governor using the spacer.

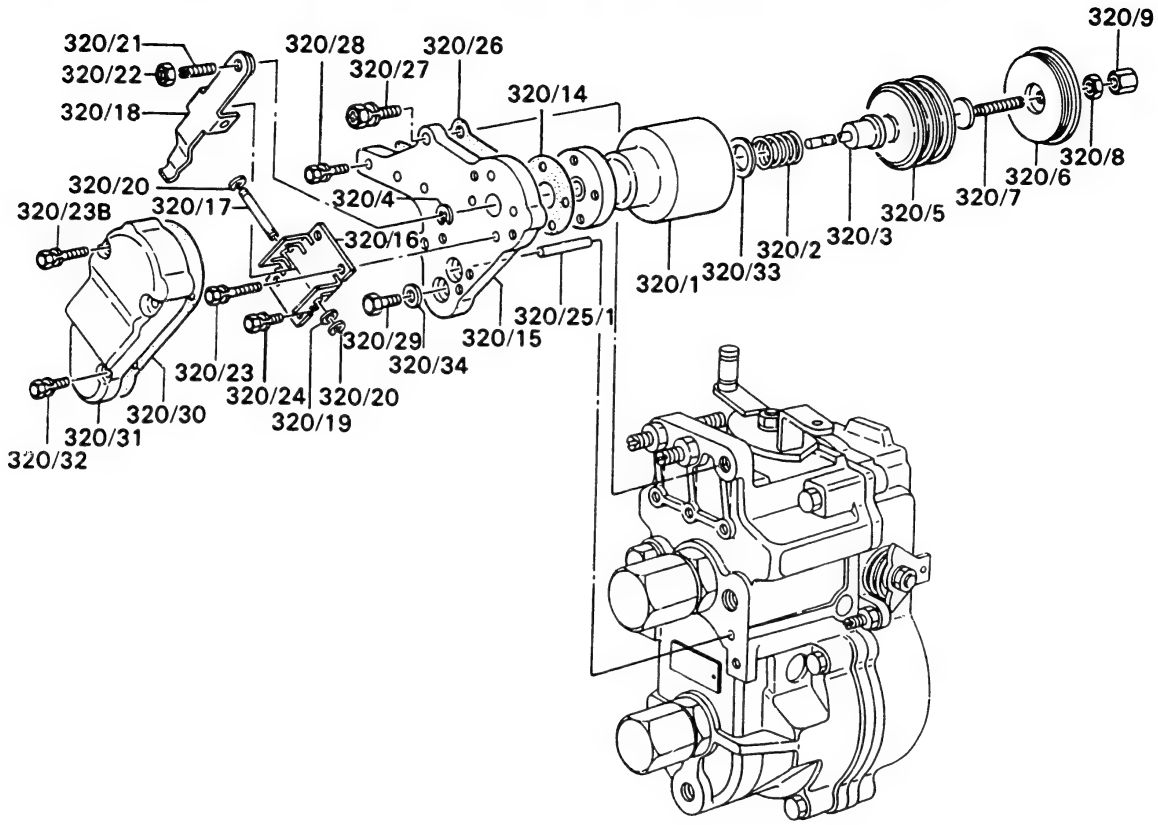


Fig. 46 Exploded view of "inverted-type" aneroid compensator

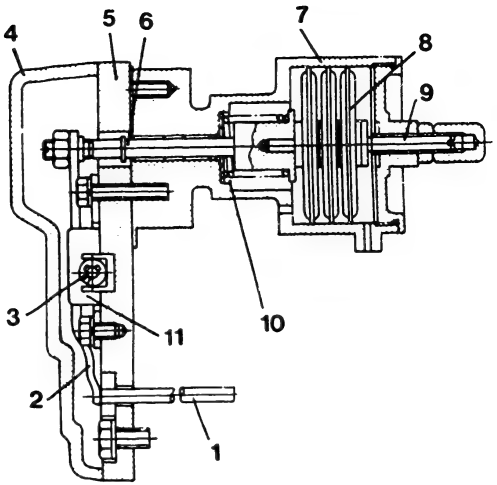


Fig. 47 Cross-sectional view of "inverted-type" aneroid compensator

1 = Pushrod (2)
2 = Inversion lever
3 = Shaft
4 = Cover
5 = Spacer
6 = Pushrod (1)
7 = Housing
8 = Bellows
9 = Set screw
10 = Aneroid compensator spring
11 = Plate

Fig. 47 shows a cross-sectional view of "inverted-type" aneroid compensator.

The "inverted-type" aneroid compensator consists of a spacer and housing (aneroid compensator body). The spacer is attached to the governor cover with 5 bolts and the housing is attached to the spacer with 4 bolts. In addition, a plate is attached to the spacer using 4 bolts. The inversion lever is attached to this plate by a shaft. The upper end of the inversion lever contacts pushrod (1), and the lower end contacts pushrod (2).

Movement of pushrod (1) is transmitted to pushrod (2) through the inversion lever.

Internal governor construction is exactly the same as that of the standard-type aneroid compensator equipped governor (see Fig. 44).

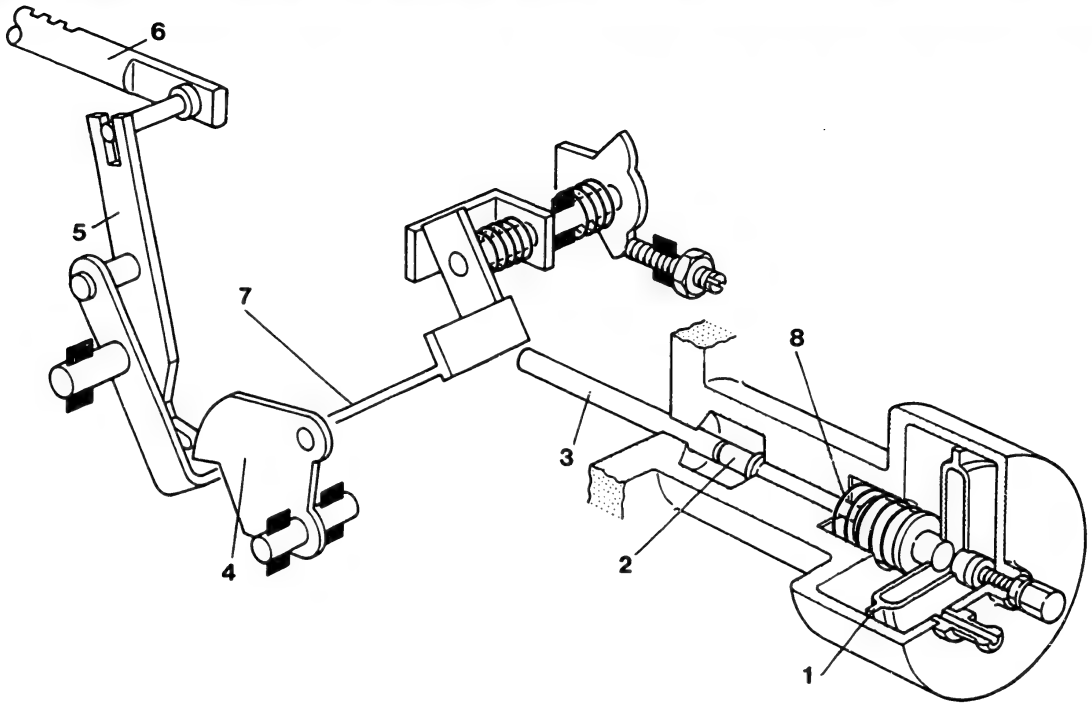


Fig. 48 Standard-type aneroid compensator prior to operation

1 = Bellows
2 = Pushrod (1)
3 = Pushrod (2)
4 = Torque cam
5 = Sensor lever
6 = Control rack
7 = U-shaped lever
8 = Aneroid compensator spring

Operation of the standard-type aneroid compensator

Fig. 48 shows the aneroid compensator prior to operation.

At low altitude the atmospheric pressure is high, and the expansion force of the bellows cannot overcome the set force of the aneroid compensator spring and cannot expand. Therefore, pushrods (1) and (2) do not move. Pushrod (2) is in a position where it does not affect movement of the U-shaped lever, and governor operation is normal. In other words, when the control lever is at the maximum speed position, any change in flyweignt lift is transmitted through the tension lever to the torque cam.

The torque cam is so shaped that it matches the torque characteristics and output characteristics when the engine is at full load. Therefore, the torque cam adjusts the fuel injection quantity through the sensor lever and control rack.

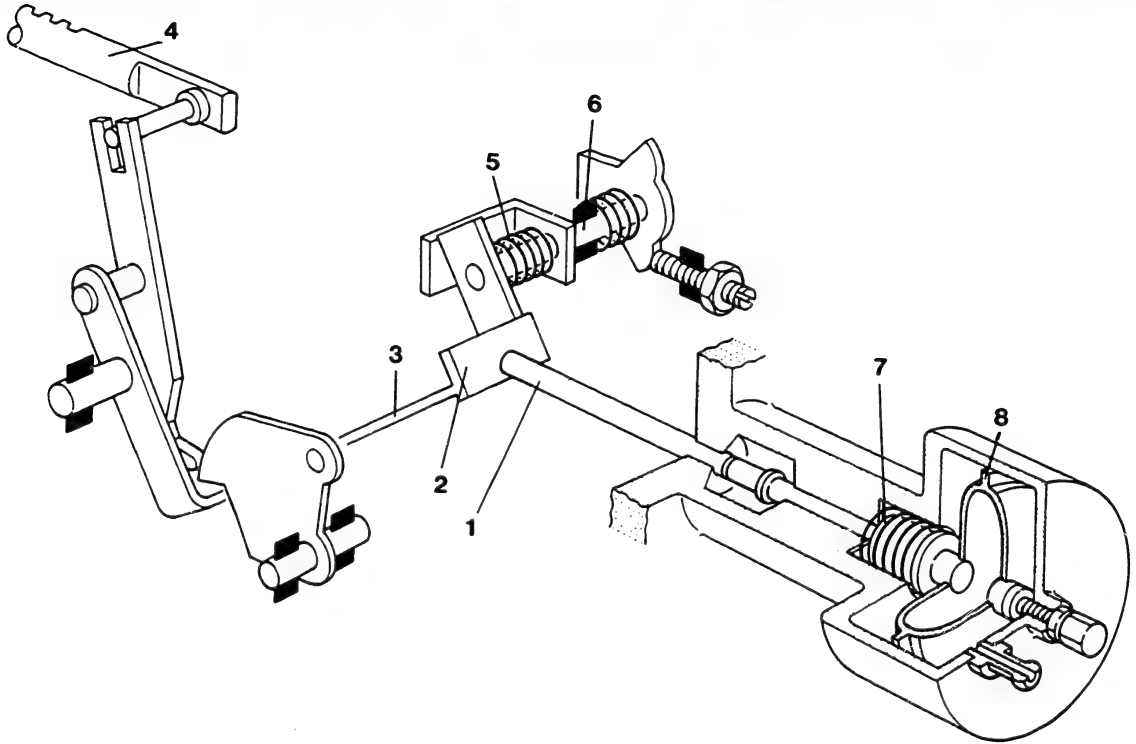


Fig. 49 Aneroid compensator operation (non-reaction range)

1 = Pushrod (2)
2 = Plate
3 = U-shaped lever
4 = Control rack
5 = Cancel spring
6 = Load control lever shaft
7 = Aneroid compensator spring
8 = Bellows

Fig. 49 shows aneroid compensator operation when there is a small reduction in atmospheric pressure.

Because of the reduction in atmospheric pressure, the bellows expands and pushes against the set force of the aneroid compensator spring. Pushrod (2) moves until it contacts the plate of the U-shaped lever. However, despite this movement, there is no change in the control rack position (non-reaction range (1) ... See Fig. 50).

The atmospheric pressure may drop further to a point where pushrod (2) pushes against the plate of the U-shaped lever, but the expansion force of the bellows is still not enough to overcome the force of the aneroid compensator spring and the cancel spring (which is attached on the load control lever shaft). As a result, the movement of pushrod (2) stops.

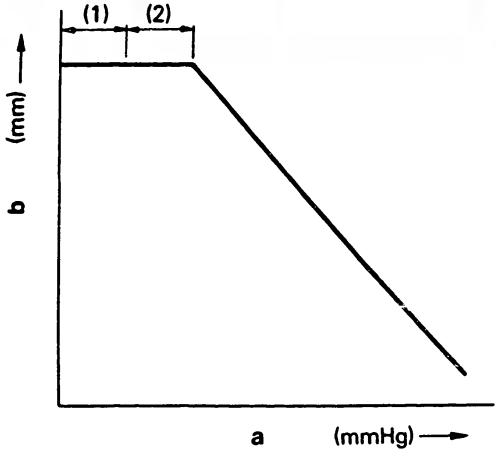


Fig. 50 Characteristic curve for aneroid compensator

a = Atmospheric pressure
b = Control rack position

This condition continues until the expansion force of the bellows overcomes the force of the aneroid compensator spring and the cancel spring. (Non-reaction range (2) ... See Fig. 50)

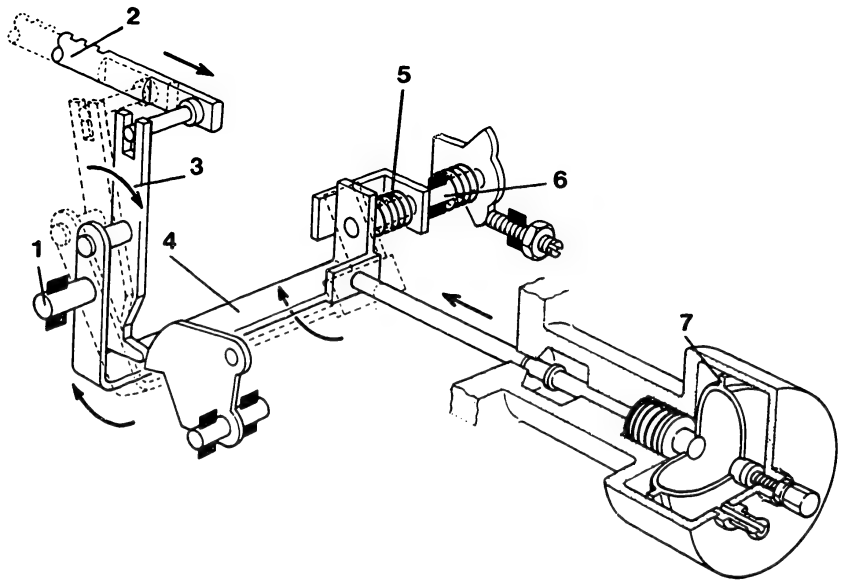


Fig. 51 Aneroid compensator operation

1 = Guide screw
2 = Control rack
3 = Sensor lever
4 = U-shaped lever
5 = Cancel spring
6 = Load control lever shaft
7 = Bellows

As the atmospheric pressure continues to decrease, the expansion force of the bellows becomes greater than the force of the aneroid compensator spring and the cancel spring, and therefore the bellows again starts to expand. The U-shaped lever then pivots about the guide screw and the load control lever shaft and moves in the direction of the arrow.

As the sensor lever is attached to the U-shaped lever, U-shaped lever movement is transmitted through the sensor lever to the control rack. The control rack moves in the "fuel-decrease" direction to reduce the fuel injection quantity to match the quantity of intake air. In this way, the system is controlled to provide an optimum balance between the fuel injection quantity and the quantity of intake air (fuel-air ratio).

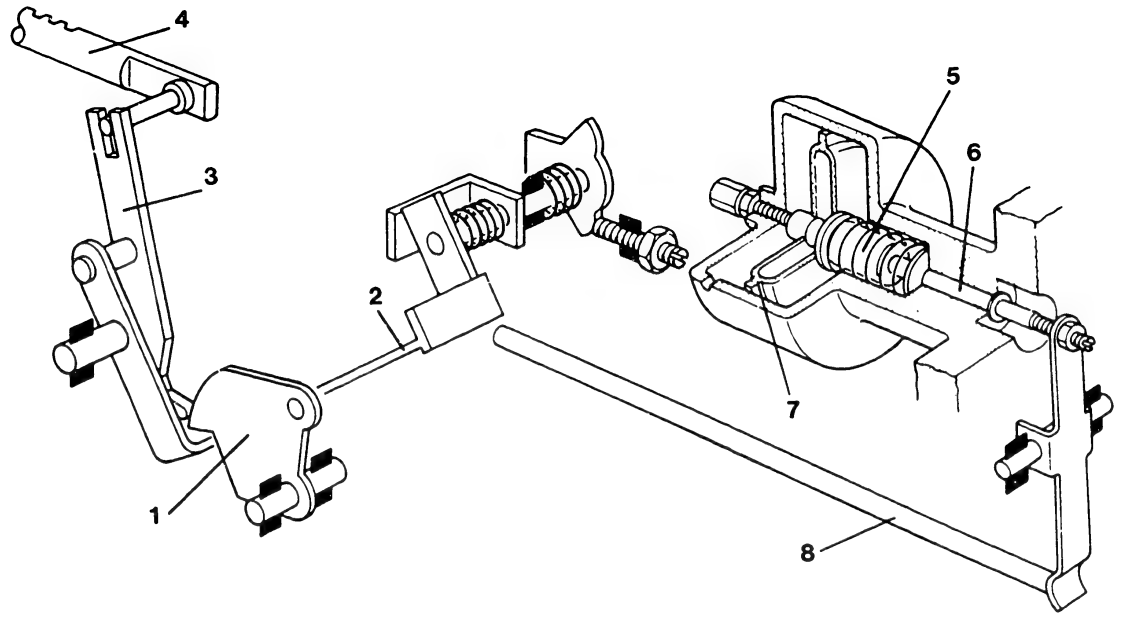


Fig. 52 "Inverted-type" aneroid compensator prior to operation

1 = Torque cam
2 = U-shaped lever
3 = Sensor lever
4 = Control rack
5 = Aneroid compensator spring
6 = Pushrod (1)
7 = Bellows
8 = Pushrod (2)

Operation of the "inverted-type" aneroid compensator

At low altitude, as atmospheric pressure is high and the expansion force of the bellows cannot overcome the set force of the aneroid compensator spring, the bellows cannot expand. Therefore, pushrods (1) and (2) do not move. Pushrod (2) is in a position where it does not interfere with U-shaped lever movement and governor operation is normal. In other words, when the control lever is at the maximum speed position, any change in flyweight lift is transmitted through the tension lever to the torque cam.

The torque cam is so shaped that it matches the torque characteristics and output characteristics when the engine is at full load. Therefore, the torque cam adjusts the fuel injection quantity through the sensor lever and control rack.

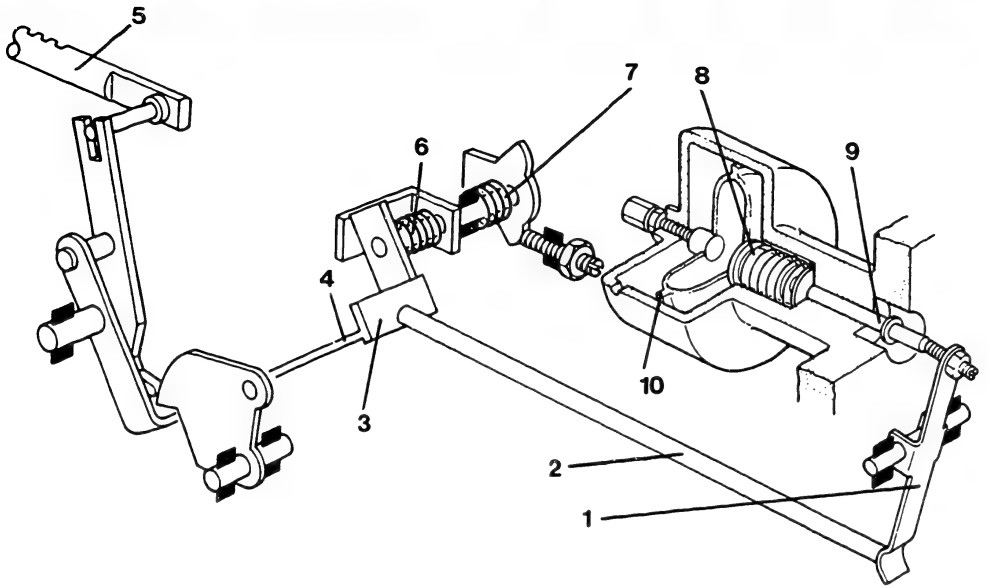


Fig. 53 Operation of "inverted-type" aneroid compensator

1 = Inversion lever
2 = Pushrod (2)
3 = Plate
4 = U-shaped lever
5 = Control rack
6 = Cancel spring
7 = Load control lever shaft
8 = Aneroid compensator spring
9 = Pushrod (1)
10 = Bellows

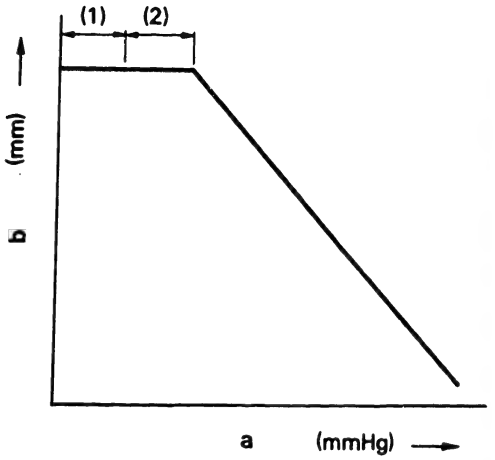


Fig. 54 Characteristic curve for aneroid compensator

a = Atmospheric pressure
b = Control rack position

Fig. 53 shows the operation of the "inverted-type" aneroid compensator when there is a small reduction in the atmospheric pressure.

Because of the reduction in atmospheric pressure, the bellows expands and pushes against the set force of the aneroid compensator spring. Movement of pushrod (1) is transmitted through the inversion lever to pushrod (2).
Pushrod (2) moves until it contacts the plate of the U-shaped lever. However, despite this movement, there is no change in the control rack position (non-reaction range (1) ... See Fig. 54).

The atmospheric pressure may drop further to a point where pushrod (2) pushes against the plate of the U-shaped lever, but the expansion force of the bellows is still not enough to overcome the force of the aneroid compensator spring and the cancel spring (which is installed on the load control lever shaft). As a result, the movement of pushrod (2) stops. This condition continues until the expansion force of the bellows overcomes the force of the aneroid compensator spring and the cancel spring. (Non-reaction range (2) ... See Fig. 54).

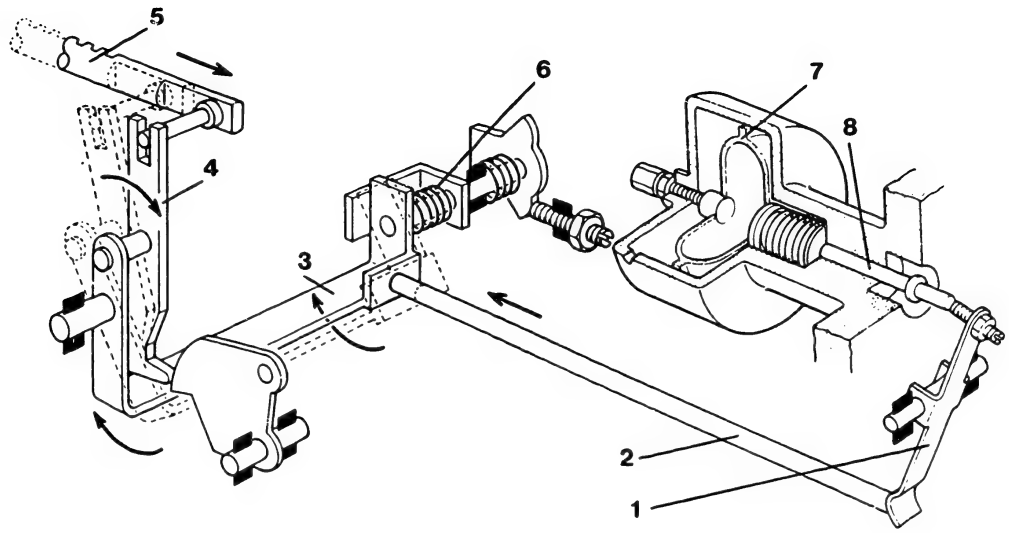


Fig. 55 Operation of "inverted-type" aneroid compensator

1 = Inversion lever
2 = Pushrod (2)
3 = U-shaped lever
4 = Sensor lever
5 = Control rack
6 = Cancel spring
7 = Bellows
8 = Pushrod (1)

As the atmospheric pressure continues to decrease, the expansion force of the bellows becomes greater than the force of the aneroid compensator spring and the cancel spring, and therefore the bellows again starts to expand. The movement of push-rod (1) is transmitted through the inversion lever to pushrod (2). Pushrod (2) pushes the plate of the U-shaped lever against the force of the aneroid compensator spring and the cancel spring and moves the U-shaped lever in the direction of the arrow (see Fig. 55).

As the sensor lever is attached to the U-shaped lever, movement of the U-shaped lever is transmitted through the sensor lever to the control rack. The control rack moves in the "fuel-decrease" direction to reduce the fuel injection quantity to match the quantity of intake air. In this way, the system is controlled to provide an optimum balance between the fuel injection quantity and the quantity of intake air (fuel-air ratio).

SPECIAL TOOLS

For service of the RLD type mechanical governor mounted on the PF(S)-A(D) pump, the following special tools and general tools should be prepared.

Service Tools for Disassembly and Reassembly

No.	Part Number	Tool Name	Q' ty	Application
1	KDEP 2919	Universal Vise	1	Used with brackets (1 685 720 017 and KDEP 2963)
2	1 685 720 017	Bracket	1	
3	KDEP 2963	Bracket	1	
4	commerc. available	Ratchet Handle	1	Used together with socket wrench
5	commerc. available	Handle	1	Used together with socket wrench
6		Box Wrench (SW 10 mm)	1	For removing and installing supply pump fixing nuts (SW 10 mm)
7	KDEP 2624	Tappet Holder	8	For holding PE(S).A pump tappets (bolt-type tappet adjustment)
8	KDEP 2608	Tappet Holder	6	For holding PE(S).A high speed type pump tappets
9	KDEP 2625	Tappet Holder	10	For holding PE(S).AD pump tappets
10	KDEP 2906	Spanner	1	For holding pump side coupling
11	KDEP 2626	Wrench	1	For removing and installing flyweight fixing nut (2.9 mm wide tooth)
12	KDEP 2918	Extractor	1	For removing flyweight and pump side coupling
13	KDEP 2628	Pin	1	For fixing extractor (Part No.: KDEP 2918)
14	1 686 430 022	Coupling	1	For camshaft rotation (for 17 mm dia. camshaft)
15	1 686 430 023	Coupling	1	For camshaft rotation (for 20 mm dia. camshaft)
16	KDEP 2629	Wrench	1	For removing RLD-E type governor shaft locknut
17	KDEP 2630	Wrench	1	For removing RLD-E type governor idling spring locknut
18	commerc. available	Box Wrench	1	For removing and installing governor housing fixing bolt (SW 12 mm)

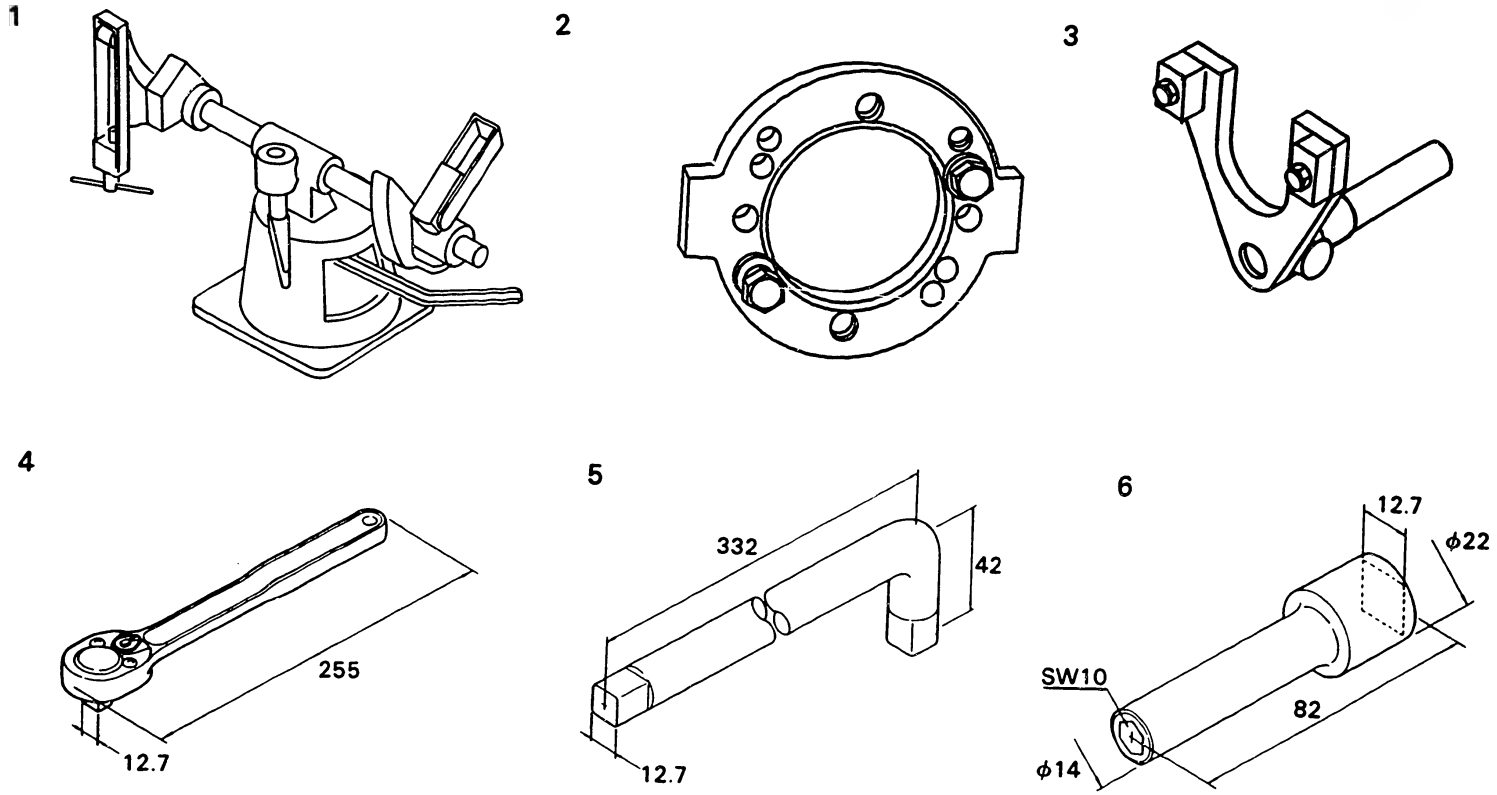


Fig. 56-1

Service tools for disassembly and reassembiy

1 = Universal Vise

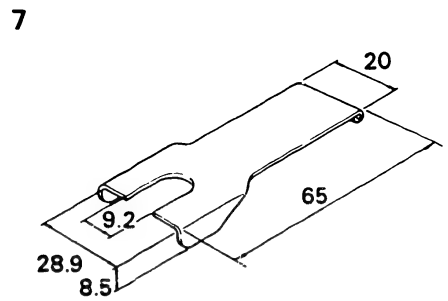
2 = Bracket

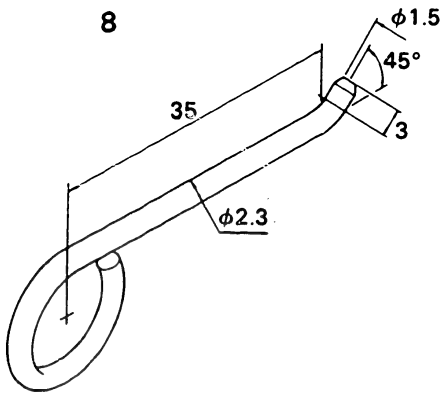
3 = Bracket

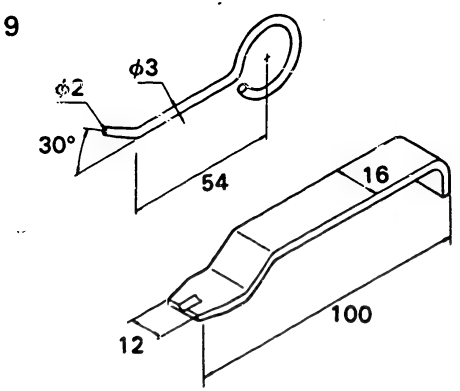
4 = Ratchet Handle

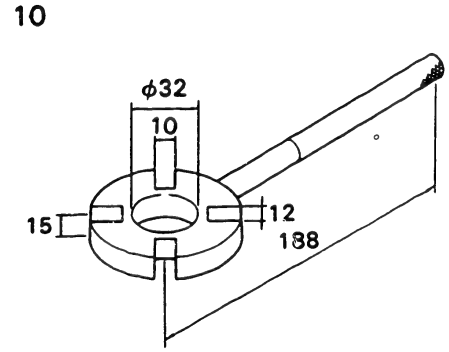
5 = Handle

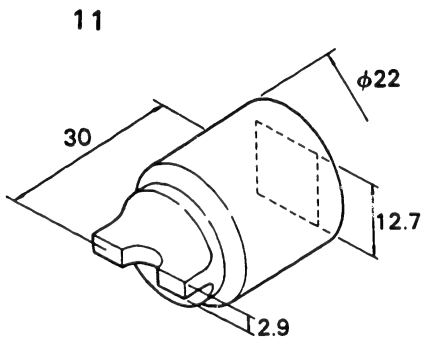
6 = Box Wrench (SW 10 mm)











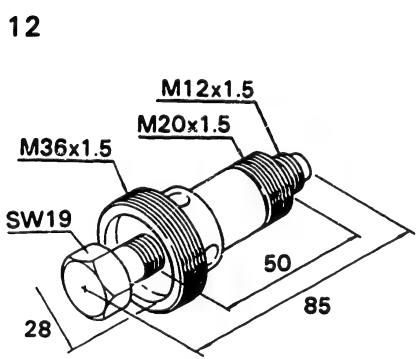


Fig. 56-2

Service tools for disassembly and reassembly

7 = Tappet holder

8 = Tappet holder

9 = Tappet holder

10 = Spanner

11 = Wrench

12 = Extractor

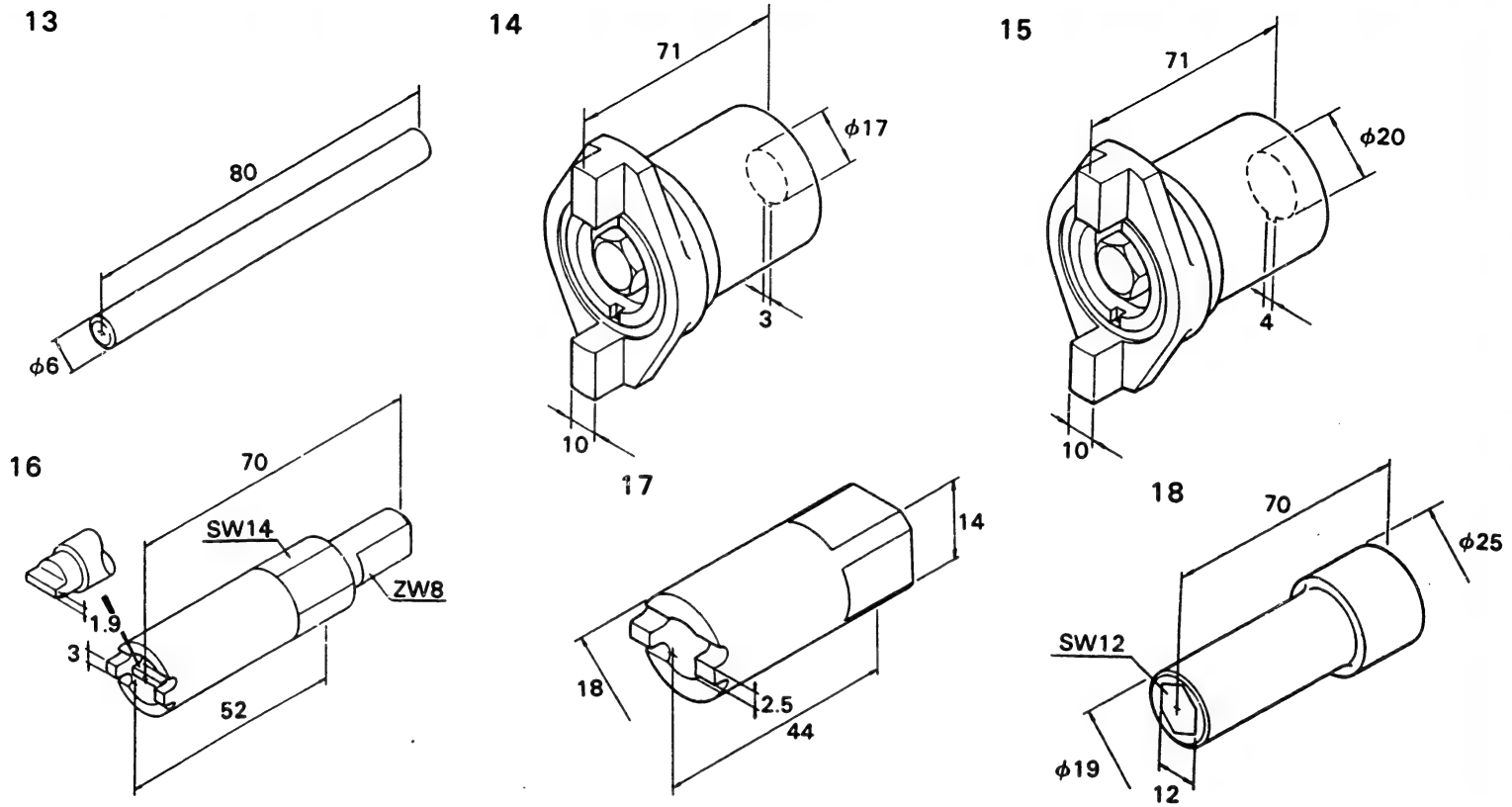


Fig. 56-3

Service tools for disassembly and reassembly

13 = Pin

14 = Coupling

15 = Coupling

16 = Wrench

17 = Wrench

18 = Box wrench (SW 12 mm)

Service Tools for Adjustment

No.	Part Number	Tool Name	Q' ty	Application
1	1 688 901 013	Nozzle Holder	8	
2	0 681 443 014	Nozzle	8	
3	1 680 750 008	Injection Pipe	8	2 mm x 6 mm x 600 mm, M 14 x 1.5; M 14 x 1.5
4	1 680 750 014	Injection Pipe	8	2 mm x 6 mm x 600 mm, M 14 x 1.5; M 12 x 1.5
5	1 688 030 044	Stand	2	For mounting PE.A(D) pump
6	1 688 120 022	Clamping Device	1	For fixing PE.A(D) pump
7	1 688 010 129	Stand	1	For fixing PE.A(D) pump
8	1 680 202 005	Adapter	1	Used together with the mounting stands (Pos. 5 and 7) Inner Dia.: 68 and 78 mm
9	1 688 130 130	Measuring Device	1	For measuring control rack travel
10	KDDC 0018	Adjusting Device	1	For measuring control lever angle and fixing control lever
11	commerc. available	Lever	1	For manual flywheel operation
12	1 686 430 022	Coupling	1	For driving injection pump (for 17 mm dia. camshaft)
13	1 686 430 023	Coupling	1	For driving injection pump (for 20 mm dia. camshaft)
14	commerc. available	Wrench (SW 7 mm)	1	For adjusting torque cam
15	KDEP 2629	Wrench	1	For adjusting governor shaft (for RLD-E type governor)
16	KDEP 2630	Wrench	1	For adjusting idling spring (for RLD-E type governor)
17	KDEP 2631	Rod	1	For press-fitting plate plug of RLD-E type governor torque cam and tension lever pin (for 18 mm dia. plug)

No.	Part Number	Tool Name	Q' ty	Application
18	KDEP 2632	Rod	1	For press-fitting plate plug of RLD-E type governor shaft (for 22 mm dia. plug)
19	KDEP 2633	Rod	1	For press-fitting plate plug of RLD-E type governor idling spring (for 26 mm dia. plug)
20	KDEP 2605	Wrench	1	For adjusting boost compensator spring (SW 10 mm; with screw-driver)
21	KDEP 2634	Wrench	1	For adjusting guide screw of improved-type boost compensator

Note: The test stand models 7 NP and 15 NP are provided with tools (Key Nos. 1, 2, 4, 6, 9 to 11 and 13 to 15) as standard.

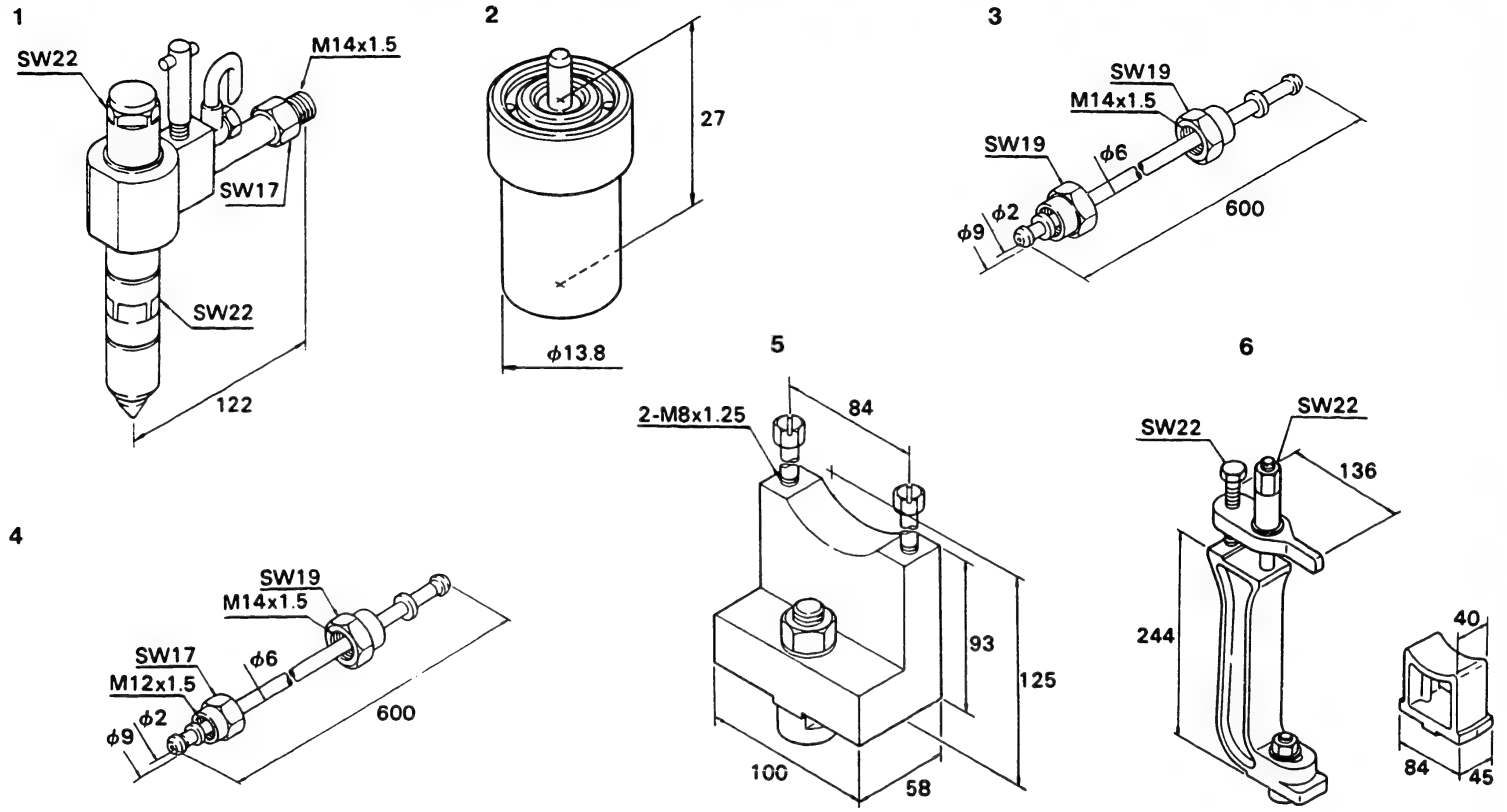


Fig. 57-1

Service tools for adjustment

1 = Nozzle Holder

2 = Nozzle

3 = Injection Pipe

4 = Injection Pipe

5 = Stand

6 = Clamping Device

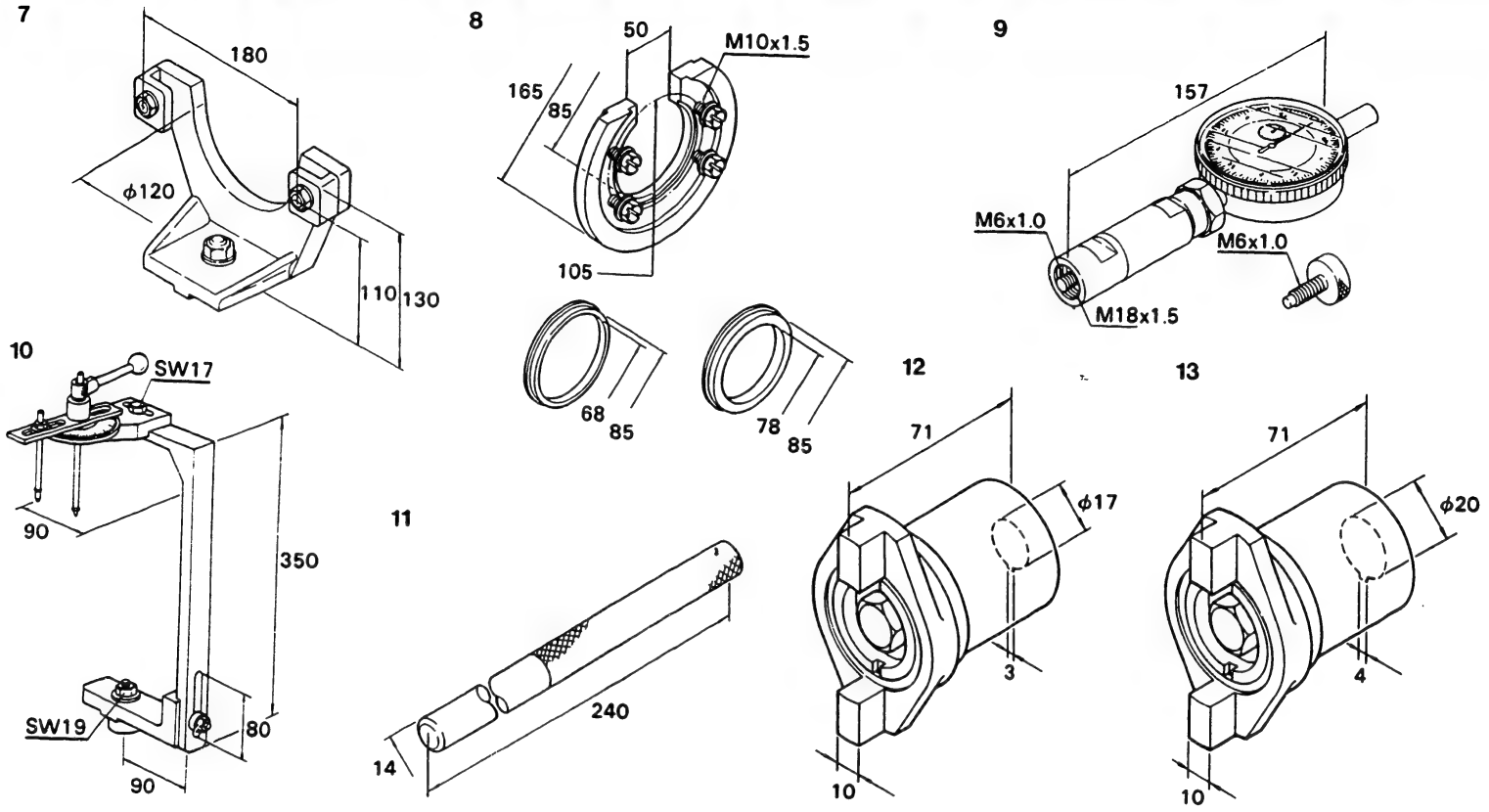
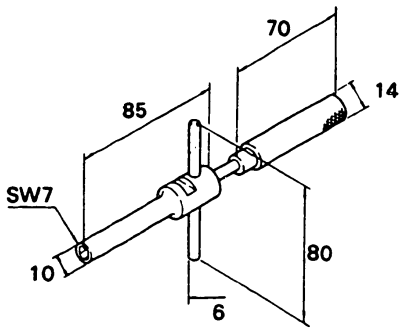


Fig. 57-2

Service tools for adjustment

7 = Stand
8 = Adapter
9 = Measuring Device
10 = Adjusting Device
11 = Lever
12 = Coupling
13 = Coupling

14



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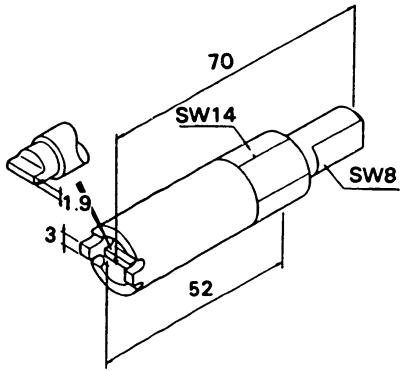

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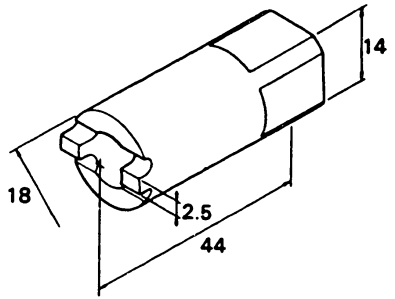

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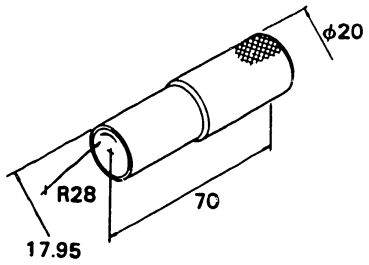

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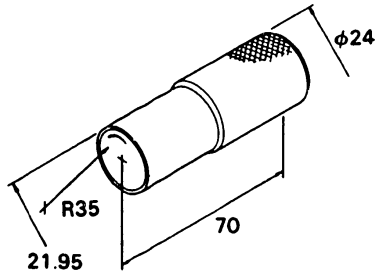

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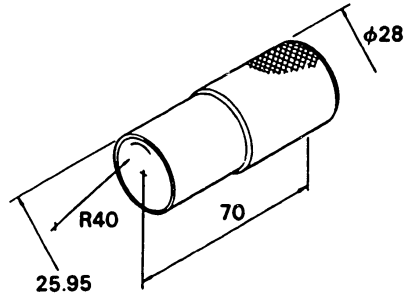


Fig. 57-3

Service tools for adjustment

14 = Wrench (SW 7 mm)

17 = Rod

15 = Wrench

18 = Rod

16 = Wrench

19 = Rod

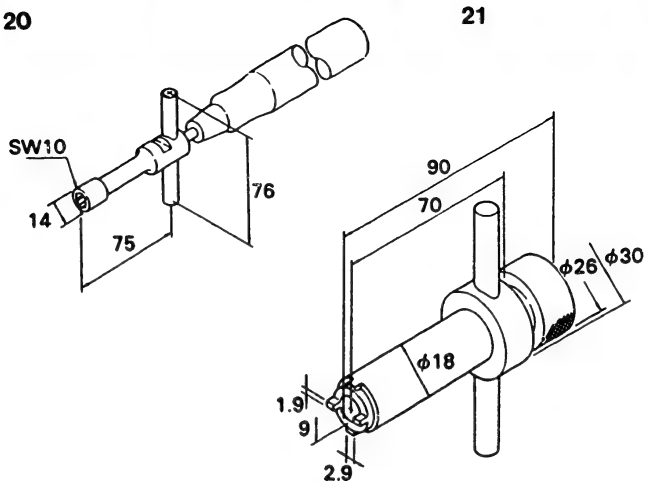


Fig. 57-4 Service tools for adjustment

20 = Wrench

21 = Wrench

Preparation for Disassembly

Be very careful when disassembling the RLD mechanical governor. Ensure the disassembly stand and the work site are clean before you start. We recommend that you record governor per-formance before you begin work; this includes the tightened position of each set screw and locknut. This will allow you to compare pre-disassembly performance data with post-reassembly performance data to determine whether the governor has resumed proper operation. Data recording is also useful for troubleshooting if it becomes necessary. Before you begin disassembly, clean off all dust and dirt from the surface of the governor and injection pump. The numbers in brackets ( ) are tool numbers and key numbers given in figure 201.

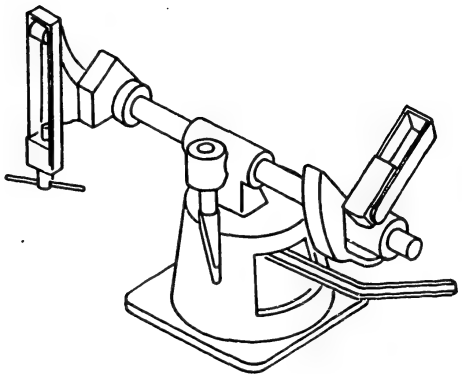


Fig. 58 Universal vise and brackets

Disassembly Procedure

The procedure described here is for the RLD-A governor (with boost compensator) mounted with the NP-PES 4 A type injection pump.

1. Remove the timing device and bracket from the injection pump, and then fit coupling (1 686 430 022) to the camshaft.

2. Remove the return spring from the control lever.

3. Mount the bracket (KDEP 2963) on the universal vise (KDEP 2919). Attach the bracket (1 685 720 017) to the bracket (KDEP 2963) using the two bolts. (Fig. 58)

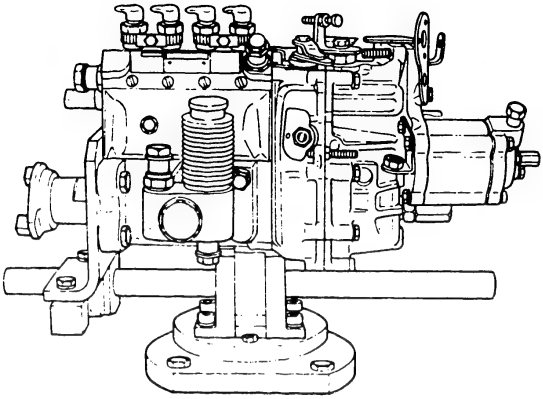


Fig. 59 Attaching the injection pump

4. Securely attach the injection pump assembly to the bracket using the four bolts.

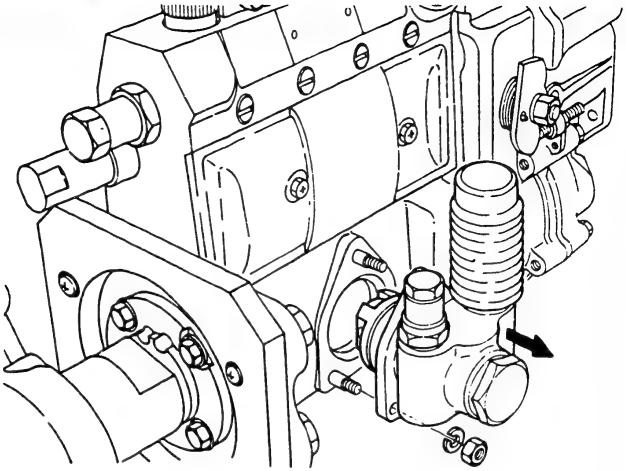


Fig. 60 Removing the supply pump

5. Remove the three nuts securing the fuel supply pump and remove the fuel supply pump.

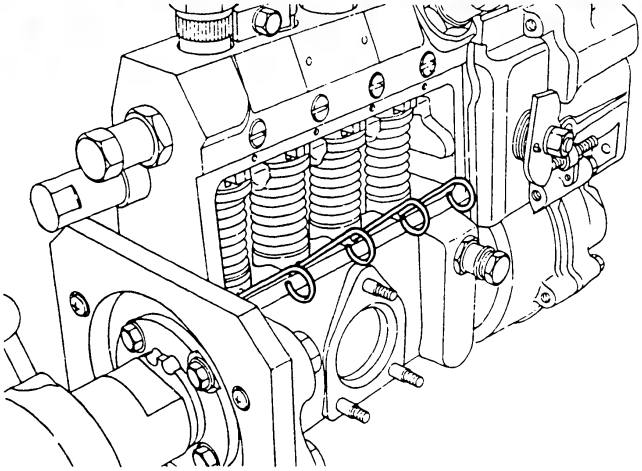


Fig. 61 Inserting the tappet holder

6. Remove the pump cover plate and, using the special wrench (KDEP 2906), rotate the camshaft. When the tappet reaches top dead center, insert the tappet holder (KDEP 2608) into the tappet hole so that the tappet can be released from the cam.

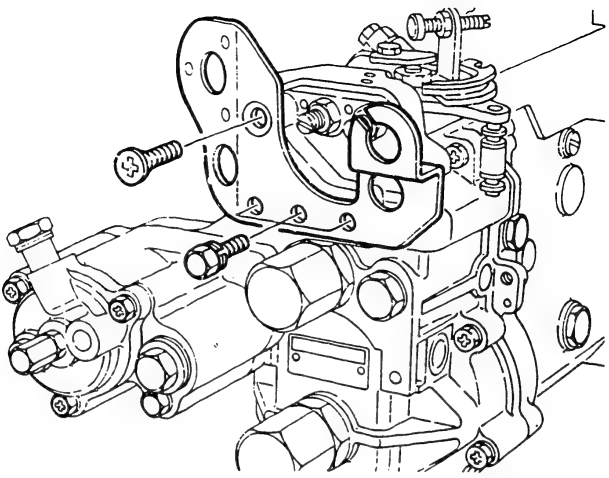


Fig. 62 Removing the stays

7. Steps 8 to 10 describe removal of the boost compensator. Proceed to step 11 if the governor is not equipped with a boost compensator.

8. Remove the three bolts (SW 10mm) and the screw securing the two stays and the boost compensator spacer.

9. Remove the stays. (Fig. 62)

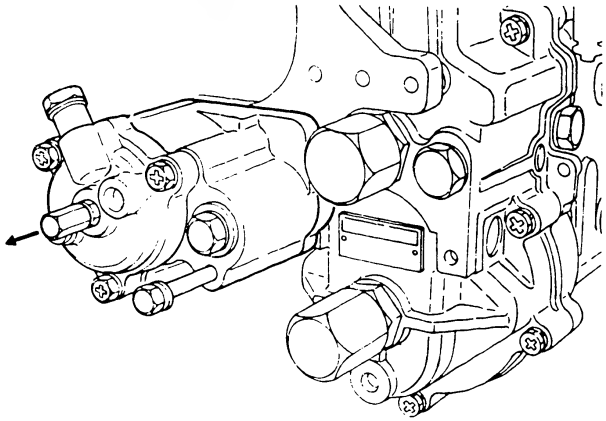


Fig. 63 Removing the boost compensator

10. Remove the bolt below the compensator adjustment access hole plug, and then remove the boost compensator from the governor cover. Be careful not to bend the pushrod.

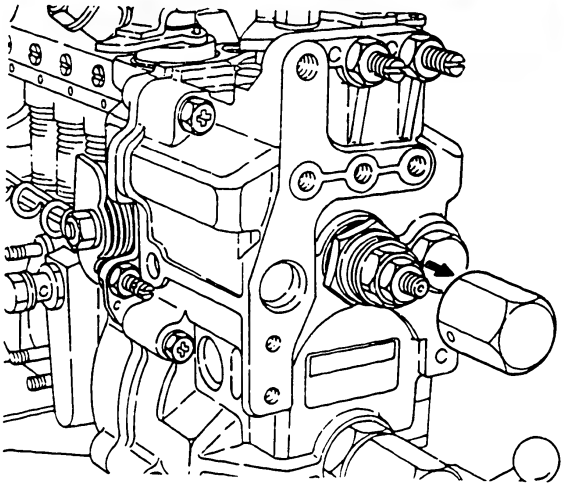


Fig. 64 Removing the capnut

11. Remove the caprut (149) and gasket (148).

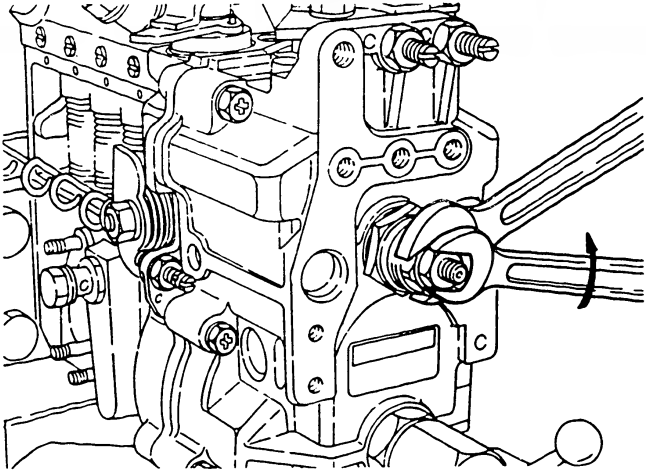


Fig. 65 Removing locknuts

12. Using two spanners (13 and 19 mm), remove two locknuts (145 and 146) from the governor shaft.

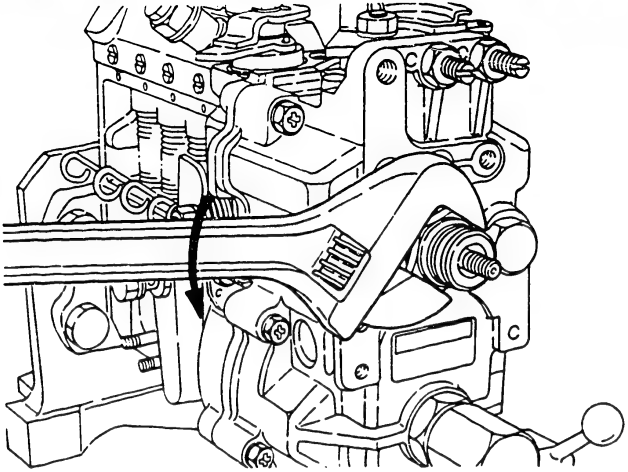


Fig. 66 Loosening the locknut

13. Loosen the locknut (147, SW 27 mm).

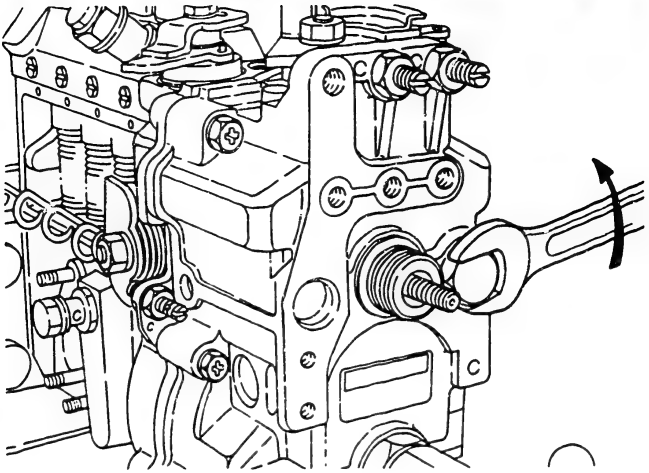


Fig. 67 Removing the access hole plug

14. Using a spanner (19 mm), remove the plug (311).

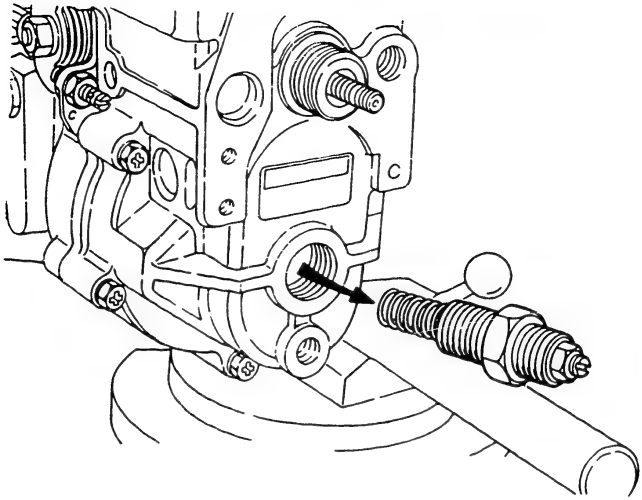


Fig. 68 Removing the idling spring capsule

15. Remove the capnut (137), and loosen the locknut (135). Then remove the idling spring capsule.

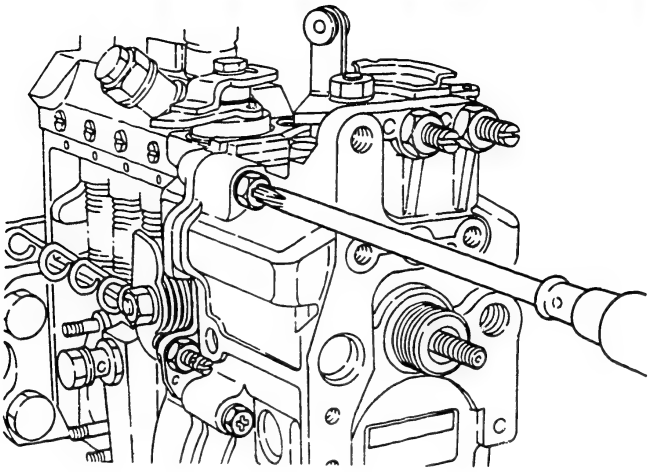


Fig. 69 Removing the governor cover bolts

16. Using a phillips-head screwdriver, remove the seven bolts (51).

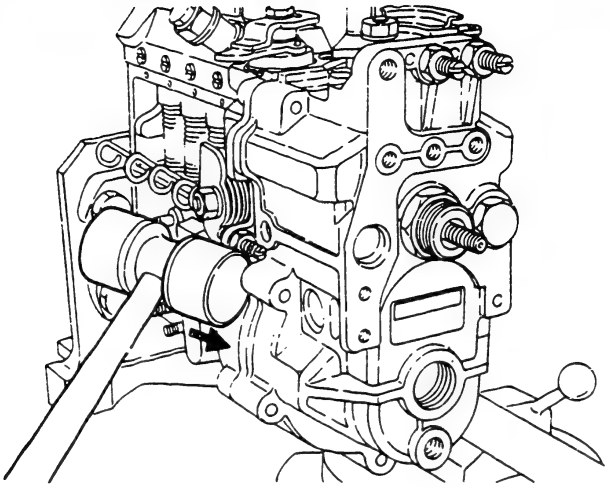


Fig. 70 Removing the governor cover

17. By tapping the governor cover (35) lightly with a mallet, separate it from the governor housing.

Note: Be sure to keep an oil pan under the governor to receive lubricating oil.

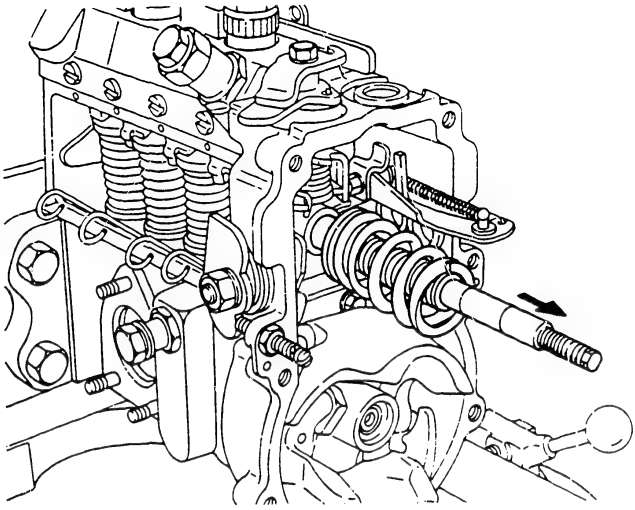


Fig. 71 Removing the governor shaft

18. Remove the governor shaft (140) together with the governor springs (130 and 131) and spring seat (150).

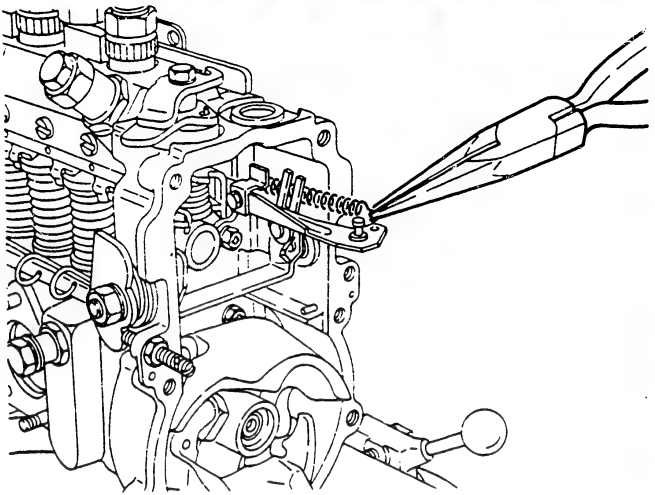


Fig. 72 Removing the start spring

19. Using long-nose pliers, remove the start spring (132) from the rack connecting link (155).

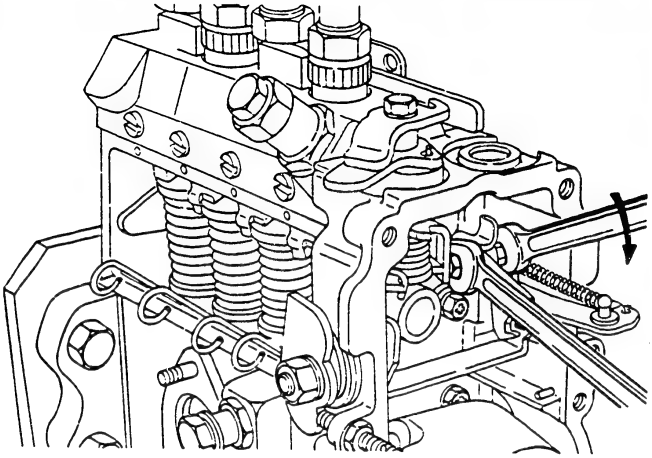


Fig. 73 Loosening the rack connecting link bolt and nut

20. Using two spanners (8 and 10mm), remove the bolt (156) and nut (158) holding the control rack and the rack connecting link in place.

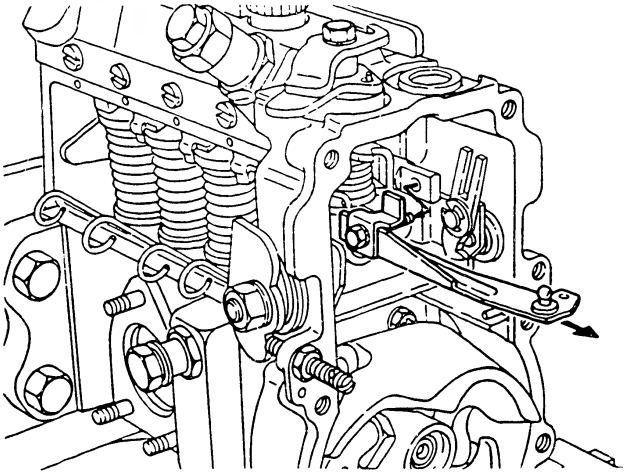


Fig. 74 Removing the rack connecting link and bolt

21. Remove the rack connecting link (155), plate (159) and bolt (156) together.

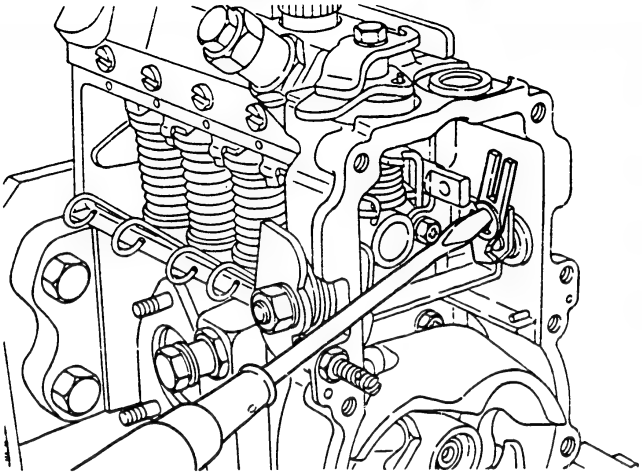


Fig. 75 Removing the snapring

22. Remove the snapring (10) from the pin of the U-Shaped lever (17) and remove the sensor lever (9).

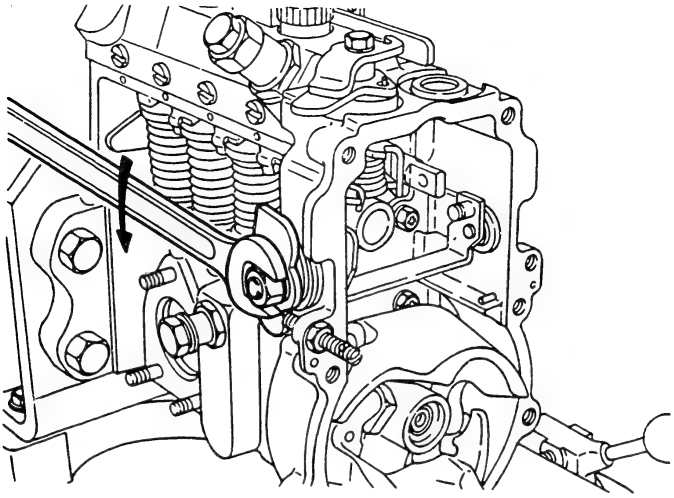


Fig. 76 Removing the full-load setting lever nut

23. After removing the nut (15), remove the full-load setting lever (13) and return spring (12) together. Then remove the O-ring (7) and shim (11).

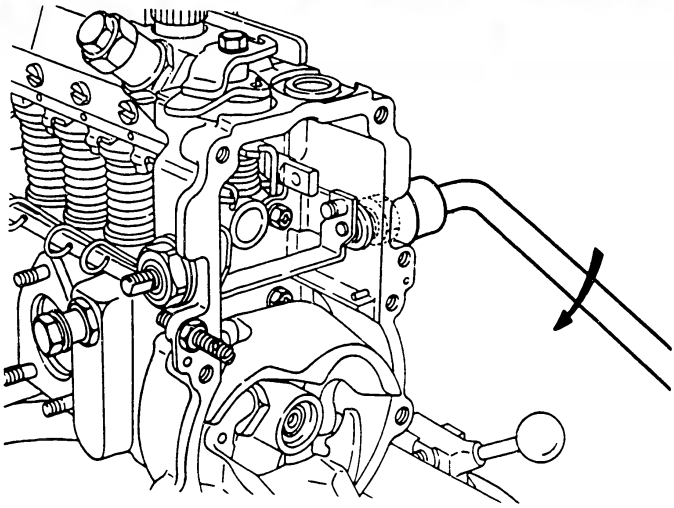


Fig. 77 Removing the guide plug

24. Remove the guide plug (16).

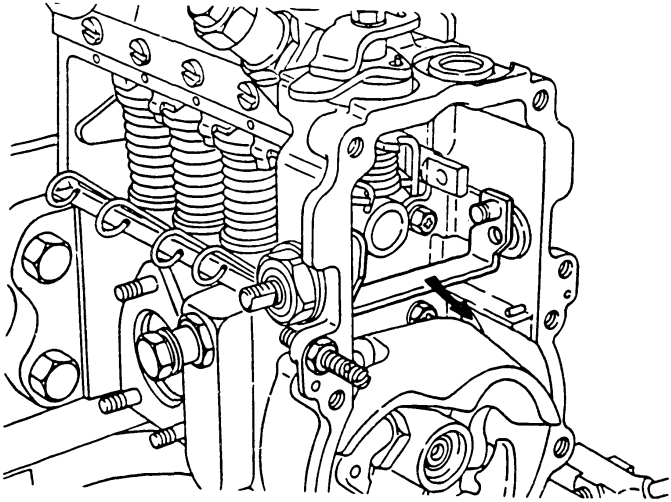


Fig. 78 Removing the U-shaped lever

25. Remove the U-shaped lever (17).

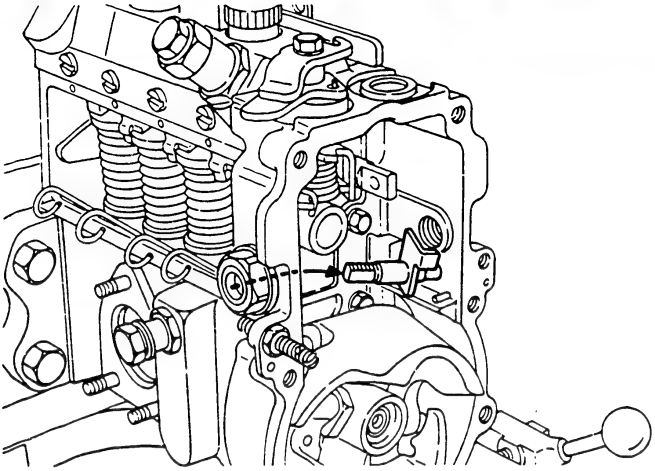


Fig. 79 Removing the full-load lever shaft

26. Remove the full-load lever shaft (8) and spring (18).

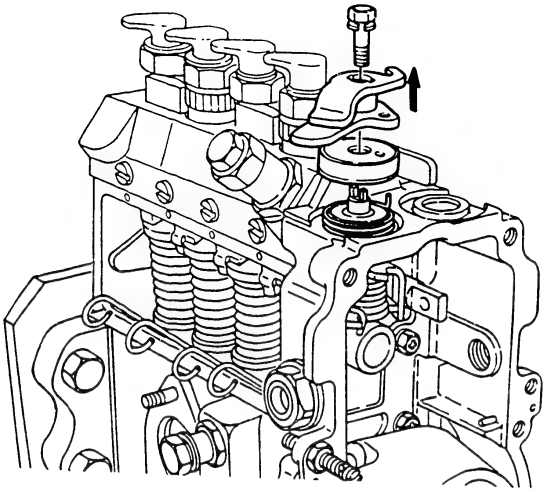


Fig. 80 Removing the stop lever

27. Remove the bolt (27), and then remove the stop lever (26), cap (25), return spring (24), O-ring (22) and shim (23).

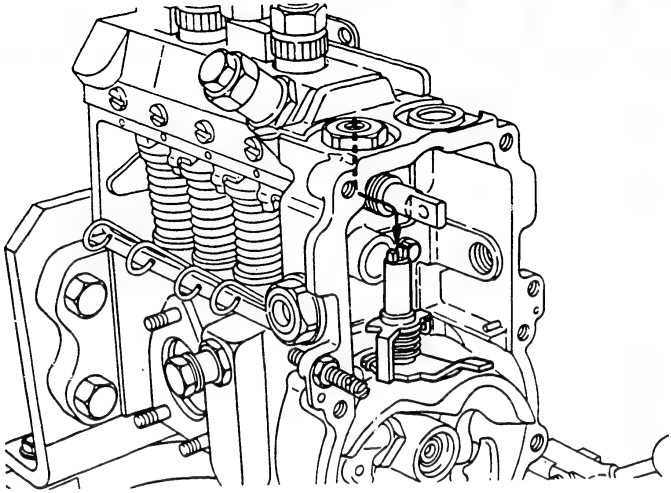


Fig. 81 Pulling out the shaft

28. Pull out the shaft (20).

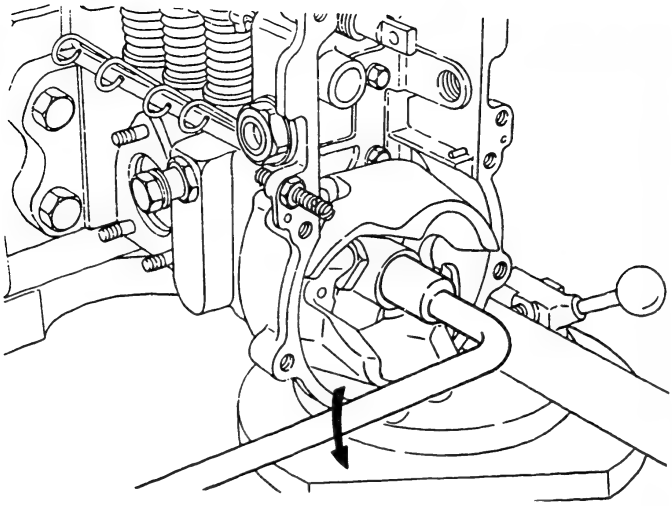


Fig. 82 Removing the locknut

29. Using the spanner (KDEP 2906), hold the coupling (1 686 430 022) so that the camshaft will not rotate.

30. Using the wrench (KDEP 2626) and L-bar handle, remove the locknut (103) securing the flyweight. (Fig. 82)

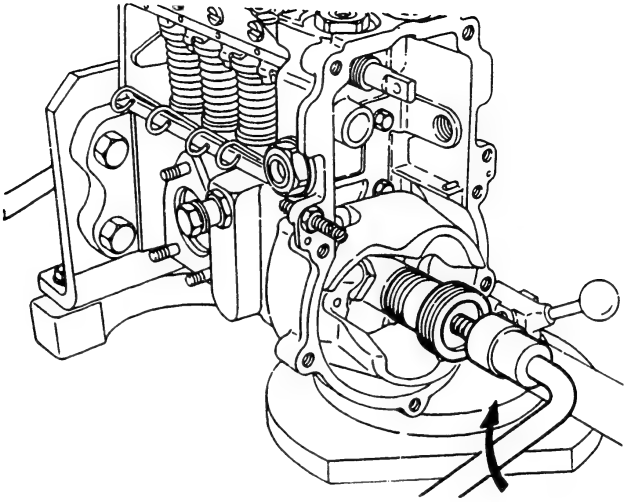


Fig. 83 Removing the flyweight assembly

31. Using the extractor (KDEP 2918), remove the flyweight assembly (100).

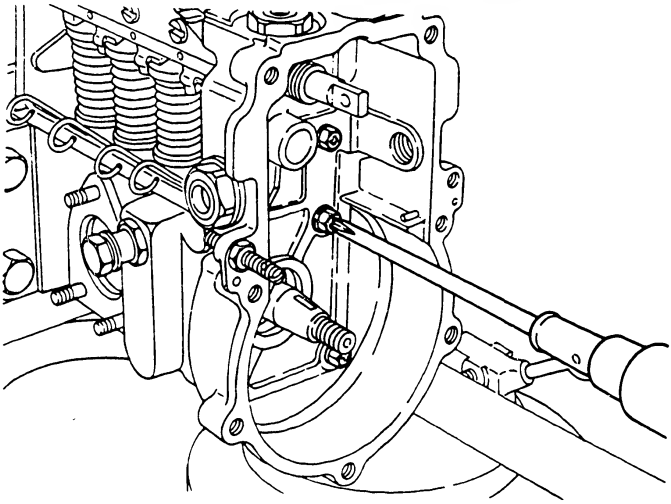


Fig. 84 Removing the bolts

32. After removing the start spring (132) from the spring eye (4), use a Phillips-head screwdriver and wrench to remove the seven bolts (3 and 5) together with the spring eye.

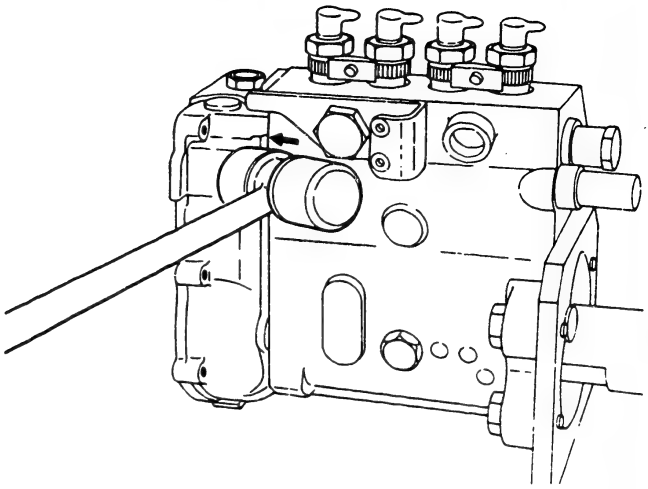


Fig. 85 Removing the governor housing

33. By tapping the governor housing lightly with a mallet, separate it from the pump housing. (Fig. 85)

The next procedure is the removal of the internal parts of the governor cover.

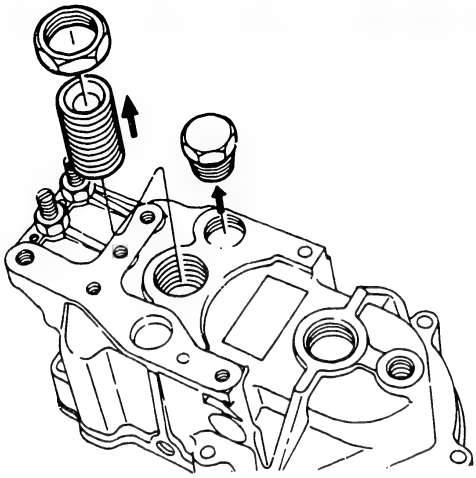


Fig. 86 Removing the guide screw and locknut

34. Remove the guide screw (141) and locknut (147) together.

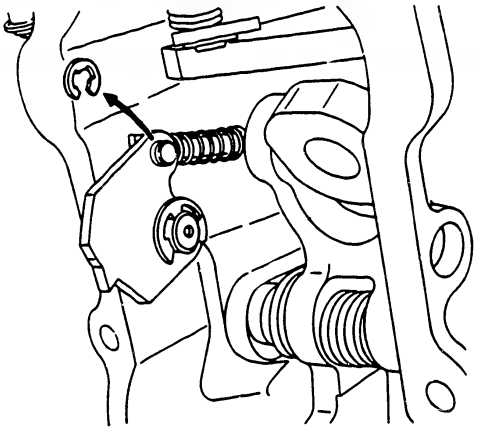


Fig. 87 Removing the rod

35. Remove the snapring (303) and then remove the rod (35/4/2) from the torque cam (300).

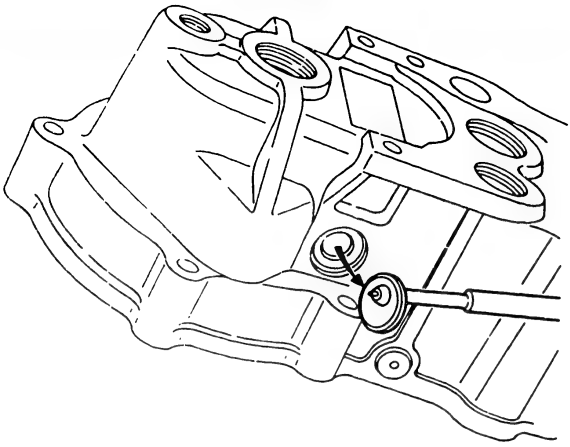


Fig. 88 Removing the plugs

36. Using a punch, remove the two plugs (35/3) press-fitted in the governor cover (35).

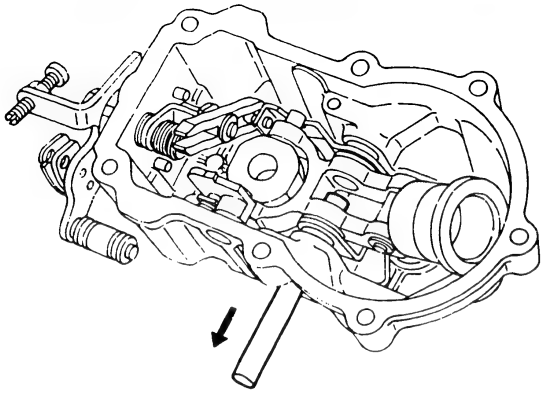


Fig. 89 Pulling out the shaft

37. Remove the hooked part of the cancel spring (35/7) from the tension lever (35/4/1).

38. Pull out the shaft (35/2). (Fig. 89)

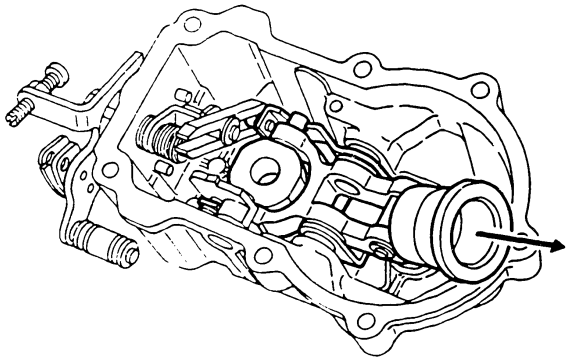


Fig. 90 Removing the tension lever assembly

39. Remove the tension lever assembly (35/4).

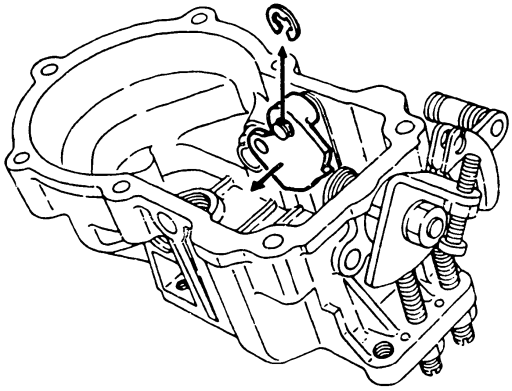


Fig. 91 Removing the torque cam

40. Remove the snapring (301), and then remove the torque cam (300) from the pin press-fitted to the governor cover.

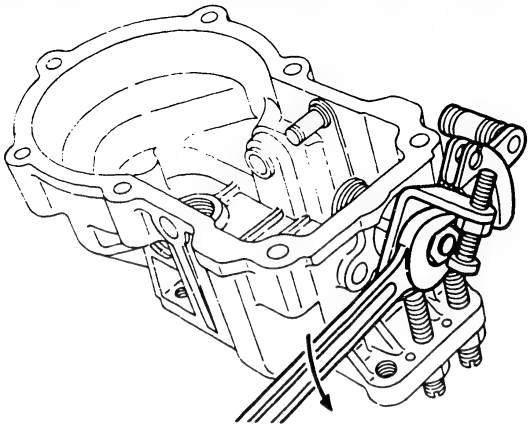


Fig. 92 Removing the control lever nut

41. Remove the nut (172), and then remove the control lever (170).

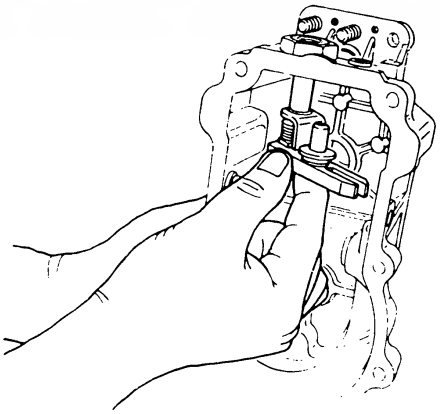


Fig. 93 Removing the floating lever assembly

42. Remove the floating lever assembly (160) from the governor cover.

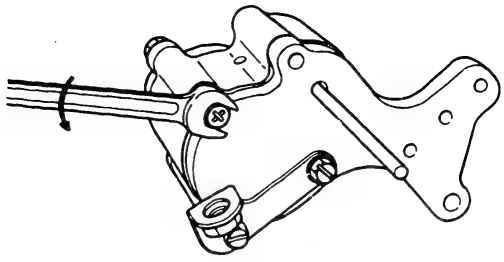


Fig. 94 Removing the bolts

The procedure for disassembling the boost compensator assembly follows.

43. Remove the three bolts (320/24), and then remove the spacer (320/1A), pushrod (320/6), spring (320/5) and washer (320/44) together. (Fig. 94)

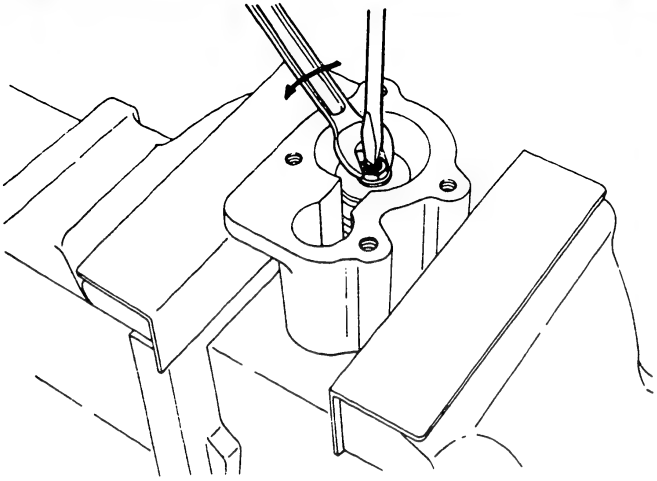


Fig. 95 Removing the locknut

44. Fix the boost compensator assembly (320) in the vise (use the jaw cover).

45. Using a screwdriver to hold the shaft, remove the locknut (320/15) and the disc (320/14). (Fig. 95)

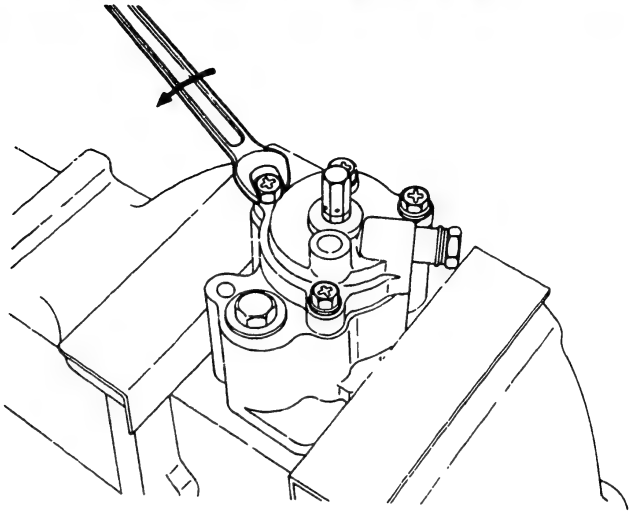


Fig. 96 Removing the bolts

46. Fix the boost compensator upside down in the vise.

47. Remove the three bolts (320/19) and the cover (320/18). (Fig. 96)

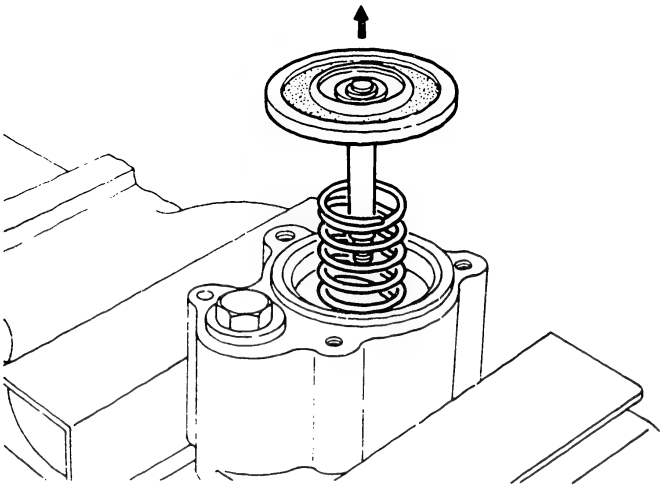


Fig. 97 Removing the diaphragm

48. Remove the diaphragm (320/11) and spring (320/16).

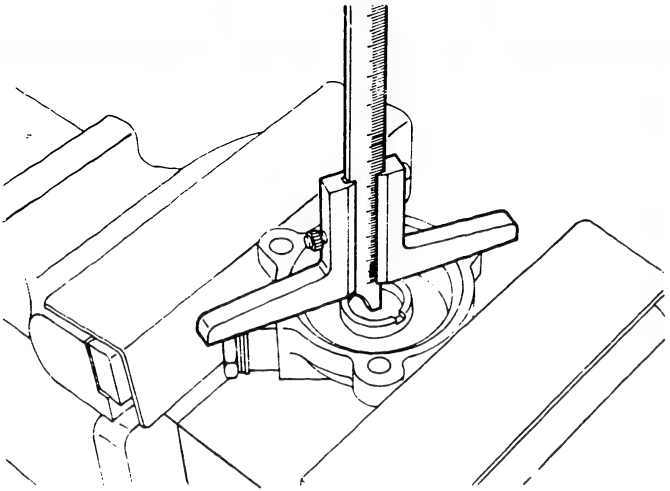


Fig. 98 Measuring the screw position

49. Before removing the screw (320/62), measure and record the distance between the edge of the cover (320/18) and the bottom of the screw. (These must be reassembled in their original positions.) (Fig. 98)

50. Remove the capnut (320/61), then loosen the nut (320/63) and remove the screw (320/62).

This completes the disassembly of the boost compensator equipped RLD mechanical governor.

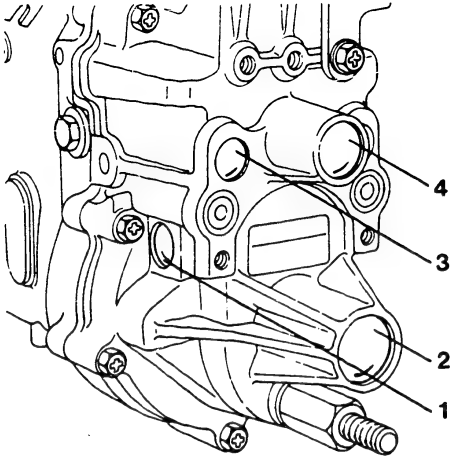


Fig. 99 Plate plug positions

1 = Plate plug (for tension lever pin)
2 = Plate plug (2)
3 = Plate plug (for torque cam)
4 = Plate plug (1)

RLD-E Type Governor Disassembly

Plate plugs (three types) are used at five locations. When removing plate plugs during disassembly, place a screwdriver tip in the center, make a hole and pull out the plate plug.

When doing this, be careful not to damage the inside surface of the governor cover.

Disassembly is explained only where parts differ from those of the RLD-A type governor.

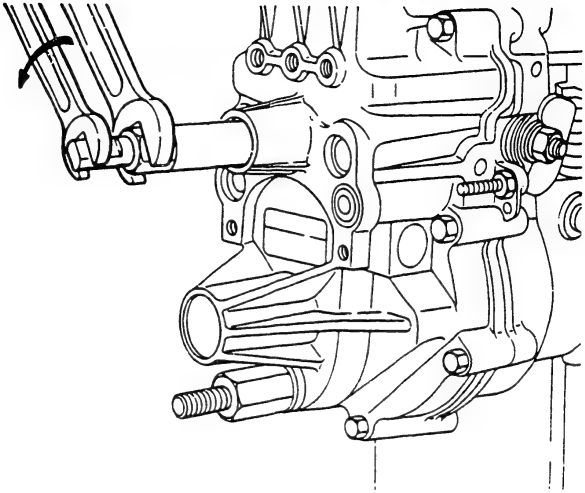


Fig. 100 Removing the governor shaft locknut

1. Removal of governor cover assembly.
   1) Remove the governor shaft plate (1), then loosen the locknut with the wrench (KDEP 2629). (Fig. 100).

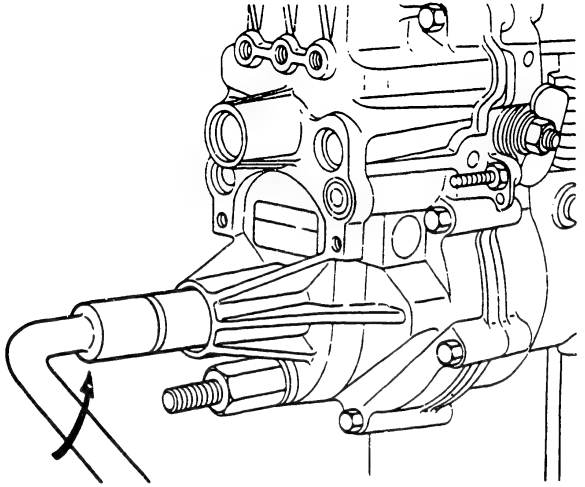


Fig. 101 Removing the idling assembly locknut

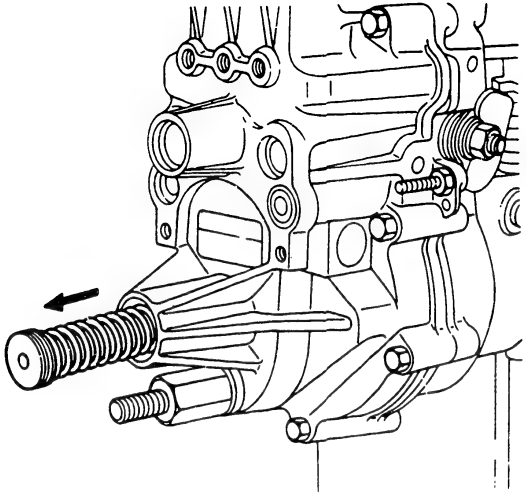


Fig. 102 Removing the idling spring assembly

2) Remove the idling spring plate plug (2), then remove the locknut with the wrench (KDEP 2630). (Fig. 101)
Next, use a Phillip' s head screwdriver to remove the idling spring assembly. (Fig. 102)

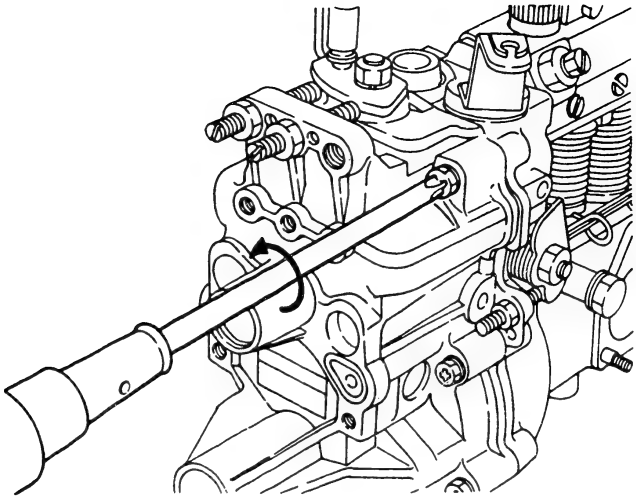


Fig. 103 Removing the governor cover assembly

3) Loosen the seven governor cover mounting bolts, then remove the governor cover assembly. (Fig. 103) Be sure to keep an oil pan under the governor to catch lubricating oil.

2. Removal of full-load setting lever

   1) Remove the rack connecting link.

   2) Hold the full-load setting lever in position and loosen the locknut.
      If the lever is allowed to turn, excessive force will be applied to the lever shaft resulting in deformation of the shaft.

   3) Remove the sensor lever and the U-shaped lever.

   4) Remove the full-load setting lever shaft.

3. Remove the flyweight.

Plate plug table

* Part No.	Outside diameter (ϕ mm)	Location
159237-5300	26	Idling spring
159237-5400	22	Governor shaft
139902-0000	18	Torque cam, tension lever pin

* Bosch Nr., see cross reference DKKC - Bosch, microfiche HB 30, HB 31

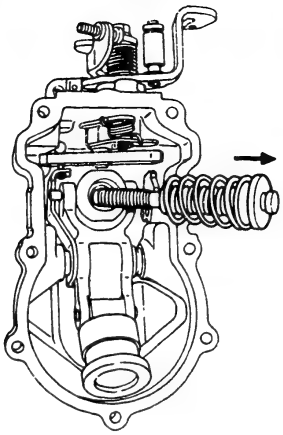


Fig. 104 Removing the governor shaft and springs

Disassemble the governor cover assembly as follows.

4. As the governor shaft is screwed directly into the cover, loosen and remove it together with the governor springs. (Fig. 104)

5. The remainder of the disassembly procedure is the same as that of the RLD model governor.

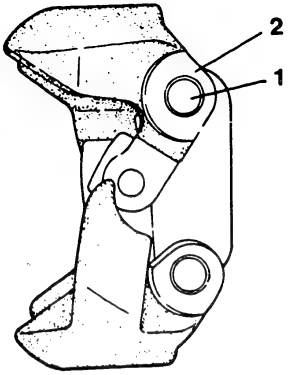


Fig. 105 Flyweight pin section

1 = Pin
2 = Flyweight

Inspect the following parts after the governor is disassembled:

Flyweight assembly

1. When the clearance between the flyweight pin and flyweight (or the flyweight bushing) is excessive due to wear, replace the flyweight assembly. (Fig. 105)

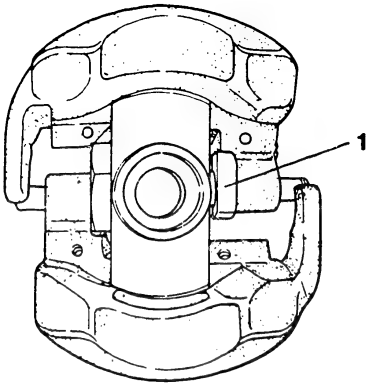


Fig. 106 Slider

1 = Slider

2. If the contact surface of the slider is worn excessively or the clearance between the slider and pin is excessive due to slider wear, replace the flyweight assembly.

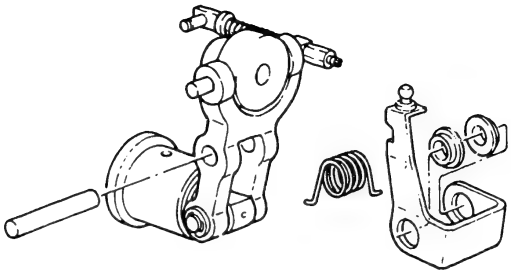


Fig. 107 Tension lever assembly

Tension lever assembly

Check each part of the tension lever assembly for wear. Any moving part that fails to move smoothly or is damaged must be replaced. Always check the following areas. (Fig. 107)

1. Contact surface between the tension lever (35/4/1) and tension lever shaft (35/2).

2. Contact surface between the tension lever shaft and bushing (35/6).

3. Contact surface between the pin (35/8) and shifter.

4. Contact surface between the pin and tension lever.

5. Contact surface between the guide lever (35/5) and bushing.

6. Each bearing must be disassembled, according to the following procedure, for inspection.

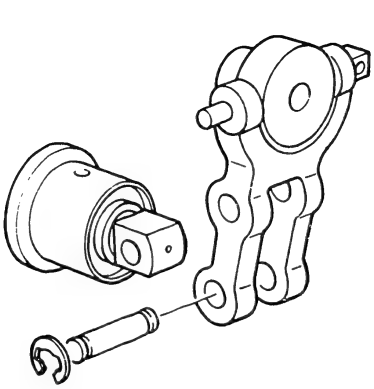


Fig. 108 Removing the pin

1) Remove the snapring (35/9) and pull out the pin (35/8).

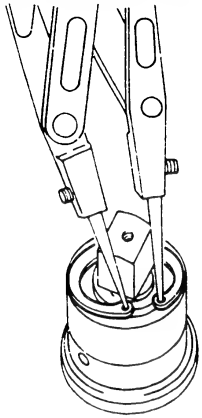


Fig. 109 Removing the snapring

2) Using snapring pliers, remove the snapring installed within the sleeve.

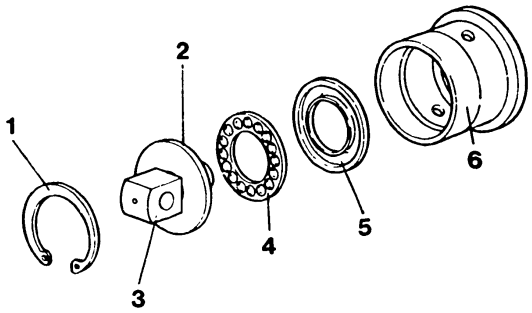


Fig. 110 Sleeve, shifter, and bearing assembly

1 = Snapring
2 = Outer ring
3 = Shifter
4 = Ball and cage ass' y
5 = Inner ring
6 = Sleeve

3) Separate the shifter and the bearing assembly from the sleeve.

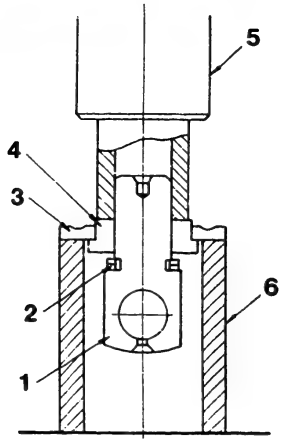


Fig. 111 Removing the outer ring

1 = Shifter
2 = Adjusting shim
3 = Outer ring
4 = Bushing
5 = Press
6 = Guide

4) Use a press to remove the outer ring of the bearing as shown in Fig. 111.

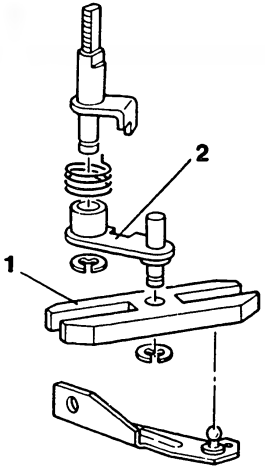


Fig. 112 Floating lever, supporting lever, and connected parts

1 = Floating lever
2 = Supporting lever

Floating lever, supporting lever, control lever shaft, and rack connecting link

Replace any part showing excessive wear. In particular, check the groove of the floating lever carefully.

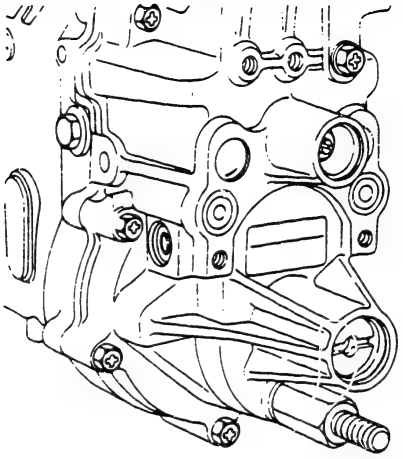


Fig. 113 RLD-E governor cover

Governor cover and governor housing

1. If the press-fitted pins in either the governor cover or housing are bent, replace the governor cover or governor housing.

2. If the bushing which supports the tension lever shaft shows excessive wear, replace the governor cover.

3. If the lip of the oil seal (167) is damaged, replace the oil seal.

4. If the inside circumference of the RDL-E governor cover is damaged, replace the governor cover. (Fig. 113)

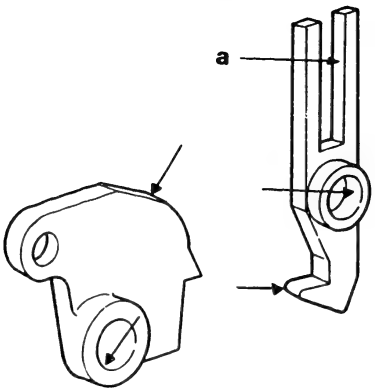


Fig. 114 Sensor lever and torque cam

a = Check for wear

Sensor lever and torque cam

If any contact surface of the sensor lever or torque cam is worn, replace the sensor lever and torque cam.

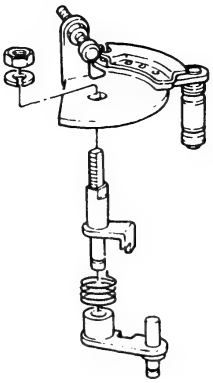


Fig. 115 Control lever assembly

Control lever, control lever shaft and supporting lever

If any contact surface of the control lever, control lever shaft or supporting lever shows signs of wear, these parts must be replaced.

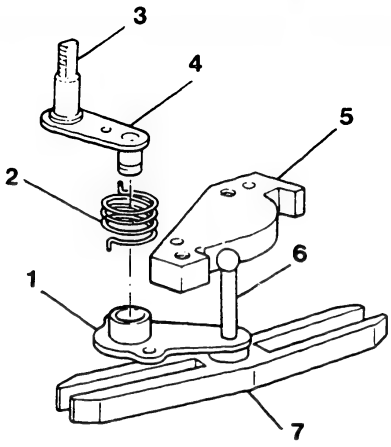


Fig. 116 Cam plate and No. 2 supporting lever

1 = No. 2 supporting lever
2 = Cancel spring (2)
3 = Control lever shaft
4 = No. 1 supporting lever
5 = Cam plate
6 = Pin
7 = Floating lever

Cam plate (RLD-C governor only)

1. If the cam surface shows excessive wear, replace the cam plate. (Fig. 116)

2. If the press-fitted pin's ball in the No. 2 supporting lever is worn, replace the No. 2 supporting lever.

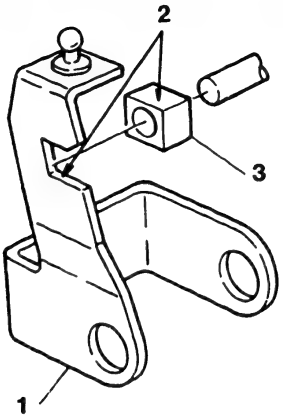


Fig. 117 Guide lever and collar

1 = Guide lever
2 = Check for wear
3 = Collar

Guide lever and collar
(RLD-B governor only)

If the groove of the guide lever of the contact surface of the collar is worn, replace the guide lever or collar.

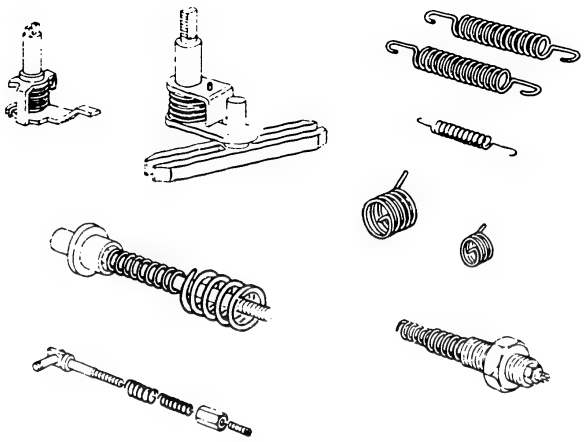


Fig. 118 Springs

Springs

Replace any springs showing signs of damage (i.e. bent, settled, etc.), flaws or rust.

REASSEMBLY

Reassembly of the RLD-A type governor is the reverse of the disassembly procedure. Points requiring special precautions during reassembly are explained below.

1. Once removed, gaskets, oil seals, O-rings, and snaprings cannot be reused. New ones must be used in reassembly.

2. Mount the full-load lever shaft (8), then fit the U-Shaped lever, the sensor lever and the rack connecting link in this sequence.

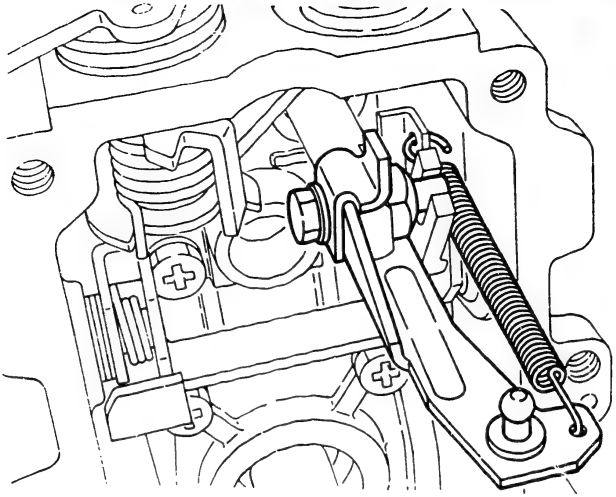


Fig. 119 Start spring

3. The start spring is set in position with its hook securely fitted from above in the hook hole of the rack connecting link. (Fig. 119)

Note: **If the start spring hook is fitted into place from underneath, it may catch in the fork groove of the floating lever and interfere with its motion.**

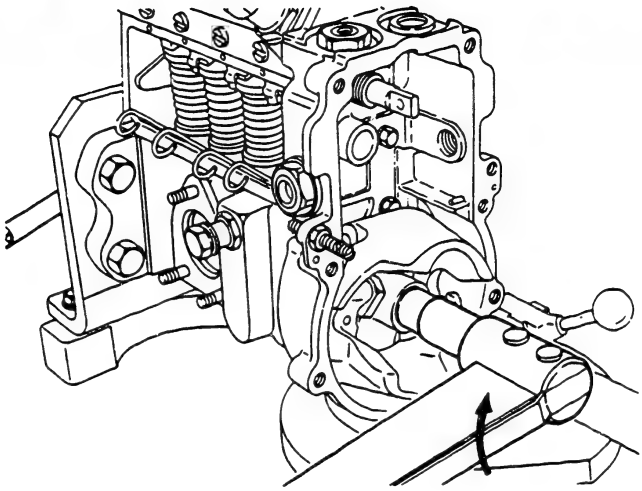


Fig. 120 Tightening the flyweight round nut

4. Be sure to tighten the round nut (103) in the flyweight assembly mounting to the specified torque. (Fig. 120).

   Specified tightening torque: 5.0 to 6.0 kg-m

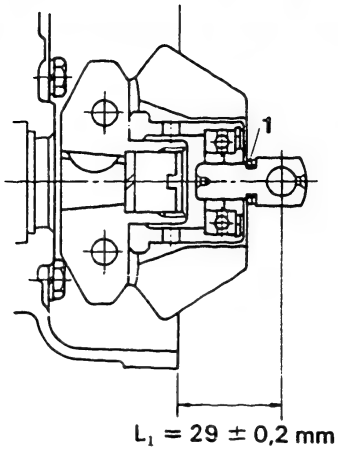


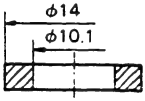
Fig. 121 Shifter position

1 = Adjusting shim

5. Mounting the shifter
   After mounting the shifter in the sleeve, insert the sleeve until it contacts the flyweight holder; keep the sleeve against the flyweight holder so that the flyweight lift will be maintained at 0. In this condition ensure that the distance between the governor housing end face and the shifter pin hole center is between 28.8 and 29.2 mm.
   If the distance is not as specified adjust the adjusting shim.

Note: If the distance exceeds 29.2 mm, the contact face of the sleeve in contact with the slider will have step-like wear. The result of such wear is improper contact between the slider and the contact face of the sleeve when the flyweights are fully open (Fig. 122).
If the distance is less than 28.8 mm, the flyweights cannot open fully (resulting in insufficient flyweight lift).

Adjusting shim table

* Part No.	Thickness (mm)	Remarks
029311-0010	0.2	 Unit: mm
029311-0180	0.3	
029311-0190	0.4	
029311-0210	1.0	
139410-0000	0.5	
139410-0100	1.5	

* Bosch Nr., see cross reference DKKC - Bosch, microfiche HB 30, HB 31

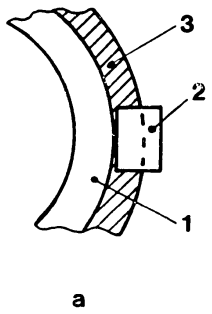


Fig. 122 Step-like wear on the sleeve

1 = Contact face of the sleeve
2 = Contact face of the slider
3 = Wear

a = Viewed from injection pump drive side

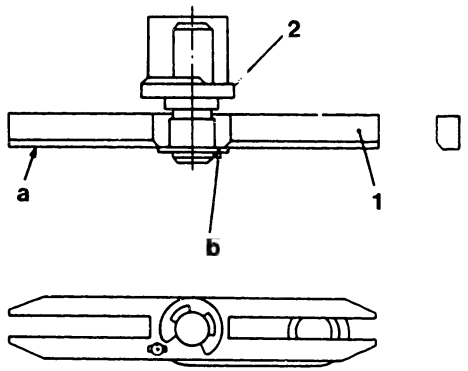


Fig. 123 Fitting the floating lever

1 = Floating lever
2 = Supporting lever

a = The side with the chamfered fork-groove
b = Stamping mark position

6. Fit the floating lever to the supporting lever, with the chamfered fork-groove of the floating lever facing down. (Fig. 123)

Note: A mark (⊙) is stamped on the side with the chamfered fork-groove.

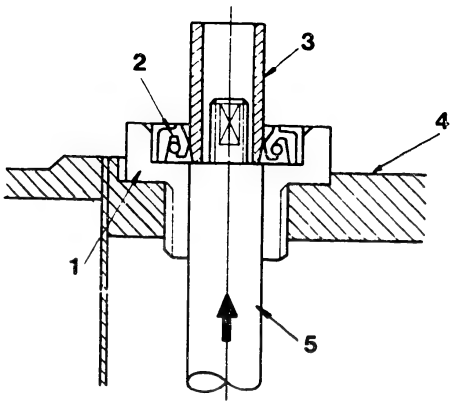


Fig. 124 Mounting the control lever shaft

1 = Bushing
2 = Oil seal
3 = Guide
4 = Governor cover
5 = Control lever shaft

7. Use an appropriate guide (i.e. a used PE(S)-A pump plunger barrel) when mounting the control lever shaft (160/6) in the bushing of the governor cover so that the oil seal will not be damaged.

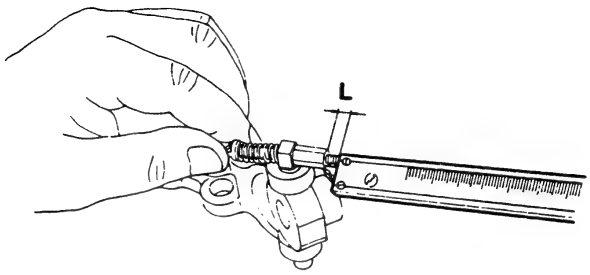


Fig. 125 Measuring the lock screw tip/ adjusting nut distance

8. If the distance between the lock screw tip and the face of the adjusting nut is changed from the original value L, adjust the distance L using the adjusting nut (35/4/3) and lock screw (35/4/4) so that a distance of 3 to 6 mm is maintained. (Fig. 125)

9. Lock the adjusting nut with the lock screw.

Note: If the adjusting nut is not locked at this time, both the lock screw and adjusting nut may work loose while the injection pump is being adjusted.

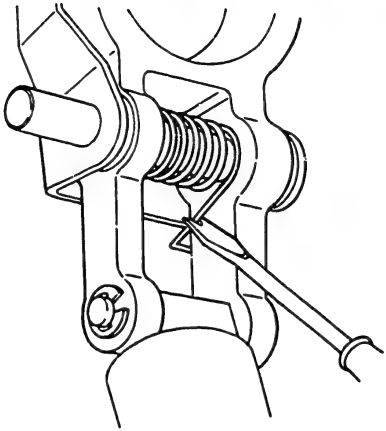


Fig. 126 Setting the cancel spring

10. For ease in attaching the cancel spring (35/7), we recommend that you use a V-notch screwdriver as shown in Fig. 126.

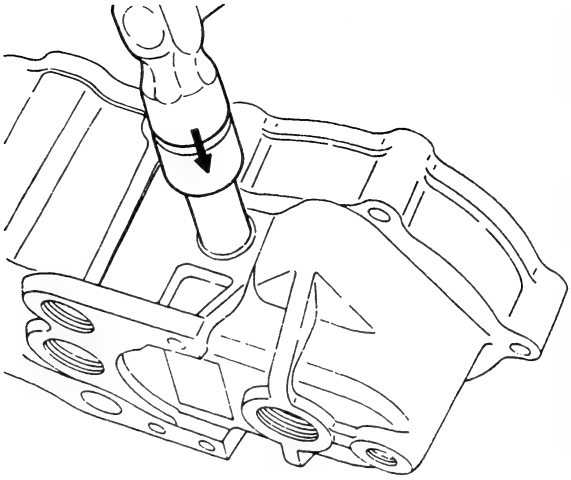


Fig. 127 Press-fitting the tension lever shaft plugs

11. The governor cover must be reassembled with new plugs (34/2) press-fitted into the governor cover : these plugs secure both ends of the tension lever shaft. Press-expand each plug to ensure a secure fit.

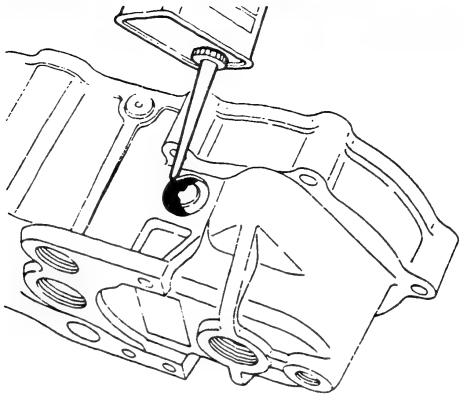


Fig. 128 Apply adhesive to the outside of the plug

12. Apply liquid adhesive to the outside of each plug to prevent leakage of lubrication oil.

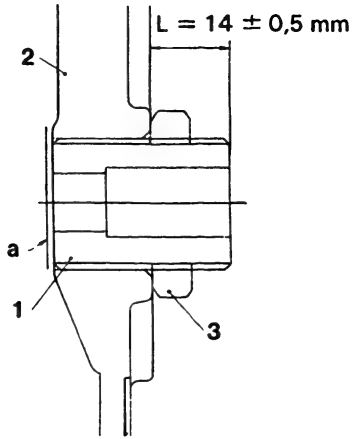


Fig. 129 Fitting the guide screw

1 = Guide screw
2 = Governor cover
3 = Nut

a = Flush face

13. Lock the guide screw (141) using the nut (147) with a distance of 13.5 - 14.5 mm maintained between the guide screw tip and the outer face of the governor cover. In this case, the opposing end of the guide screw is approximately flush with the inner face of the governor cover.

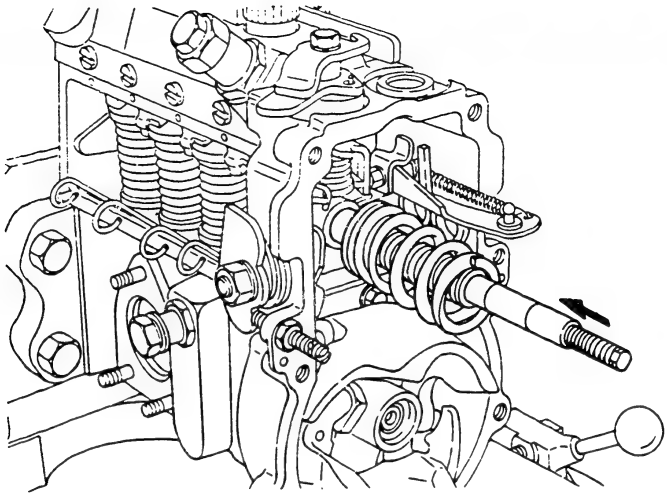


Fig. 130 Inserting the governor shaft

14. Insert the governor shaft, which has already been mounted with a spring seat (150) and governor springs (130 and 131), into the governor housing.

Note: The spring seat must be mounted on the governor shaft with the step of the spring seat facing toward the governor springs (the governor housing side is flat).

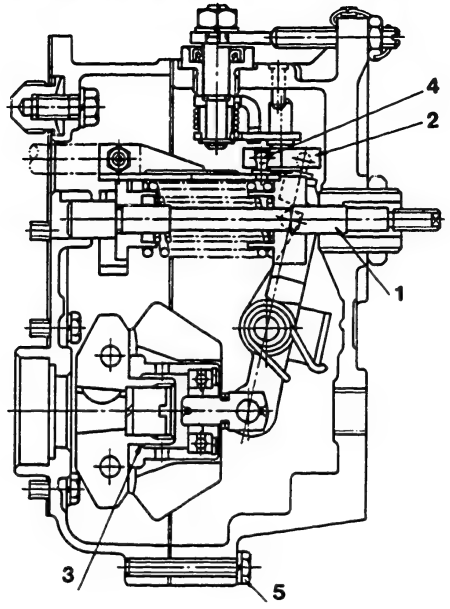


Fig. 131 Installation of the governor cover assembly

1 = Step 1) 2 = Step 2) 3 = Step 3) 4 = Step 4) 5 = Step 5)

15. Governor cover assembly installation sequence (Fig. 131)

1) First set the tension lever spring seat with the spring seat step facing towards the governor springs, and insert the governor shaft into the center hole of the spring seat.

2) Insert the guide lever ball joint into the fork-groove in the floating lever.

3) Fit the sleeve into the flyweight holder.

4) Push the control rack toward the governor and hold. Next, insert the connecting link ball joint into the fork groove of the floating lever.

5. Finally, tighten the seven bolts in diagonal sequence, with a uniform torque applied to each bolt.

Specified tightening torque: 0.7 to 0.9 kg-m

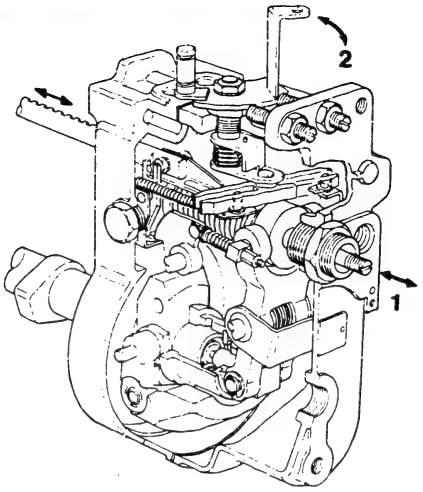


Fig. 132 Confirmation of the governor shaft and control rack sliding resistance

1 = Step 1) 2 = Step 2)

16. After installation of the governor cover assembly, check the following (Fig. 132):

1) Ensure the governor shaft can be moved smoothly by hand.

Note: If governor shaft movement is difficult, loosen the seven bolts of the governor cover, slide the governor cover until the governor shaft center is aligned with the guide screw hole center, and then retighten these bolts.

2) Check that the control rack moves smoothly when operating the control lever.

Note: Should the control rack movement be difficult, remove the governor cover assembly and determine the cause.

ADJUSTMENT

After the RLD type governor is reassembled, the following adjustments are necessary.

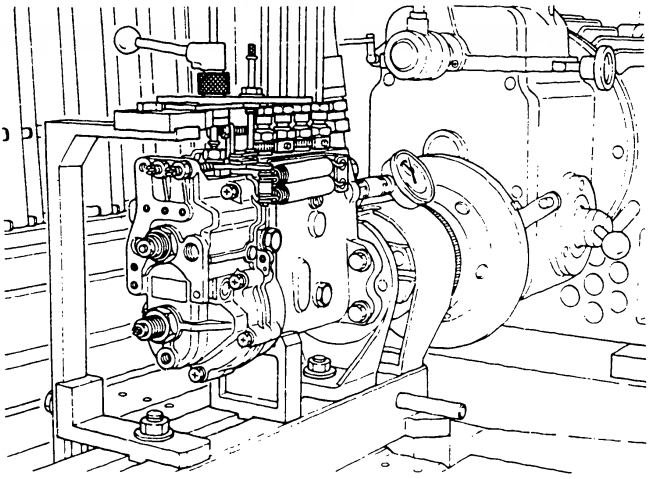


Fig. 133 Mounting the injection pump

PREPARATION

Follow the instructions below to prepare for adjustment.

1. Secure the fuel injection pump on the pump test stand and fill both the governor chamber and cam chamber with lubricating oil. (Fig. 133)

2. Remove the idling spring assembly, boost compensator and governor shaft locknut.

3. Loosen the maximum-speed setting bolt, idling speed setting bolt and full-load setting bolt.

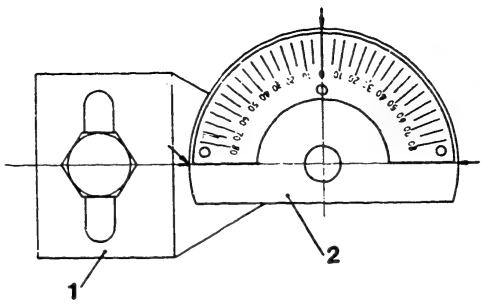


Fig. 134 Fixing the scale plate

1 = Supporting bracket
2 = Scale plate

4. Mounting the adjusting device (KDDC 0018).

1) Align the mark on the supporting bracket with the matching mark on the scale plate, then tighten the locknut. (Fig. 134)

Note: The angle scale plate has three matching marks; you can use any that is convenient.

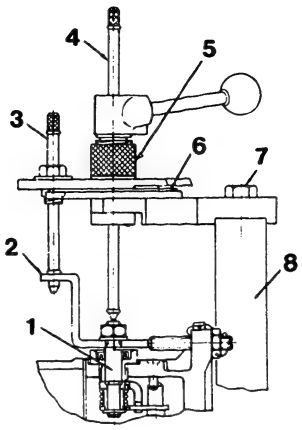


Fig. 135 Mounting the adjusting device

1 = Control lever shaft
2 = Control lever
3 = Pin B
4 = Pin A
5 = Locknut
6 = Scale plate
7 = Adjust bolt
8 = Stand

2) Move the supporting bracket to position pin A over the center hole of the control lever shaft and bolt the supporting bracket. Then, insert pin B into the rod connecting hole of the control lever.

3) Loosen the handle to check that it moves smoothly when the control lever is operated

5. The torque cam adjusting nut must be kept tight with the lock screw, as shown in Fig. 125.

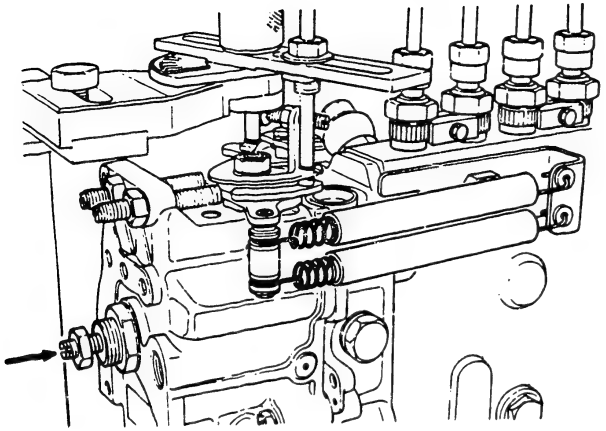


Fig. 136

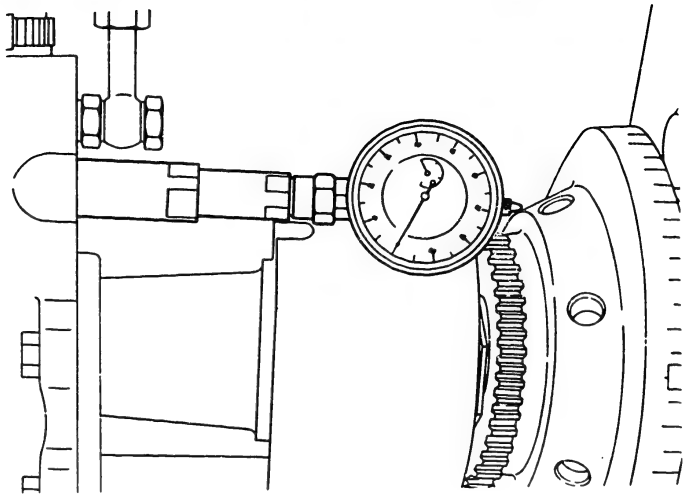


Fig. 137

Setting the Control Rack' s Zero Position

1. Mount the control rack travel measuring device (1 688 130 130) on the end of the control rack.
2. Lock the control lever at the idling position.
3. Push the governor shaft until it comes into contact with the wall of the pump housing, and keeping the pump speed between 1,000 - 1,200 rpm set the control rack at the position where the dial gauge indicates a zero reading (Fig. 136 and 137).

Note: The control rack of the RLD type governor-mounted fuel injection pump cannot be set at zero unless the pump is operated at 1,000 to 1,200 rpm. If the control rack is pushed to the non-injection position while the injection pump is running at less than 1,000 rpm, the governor links may be damaged.

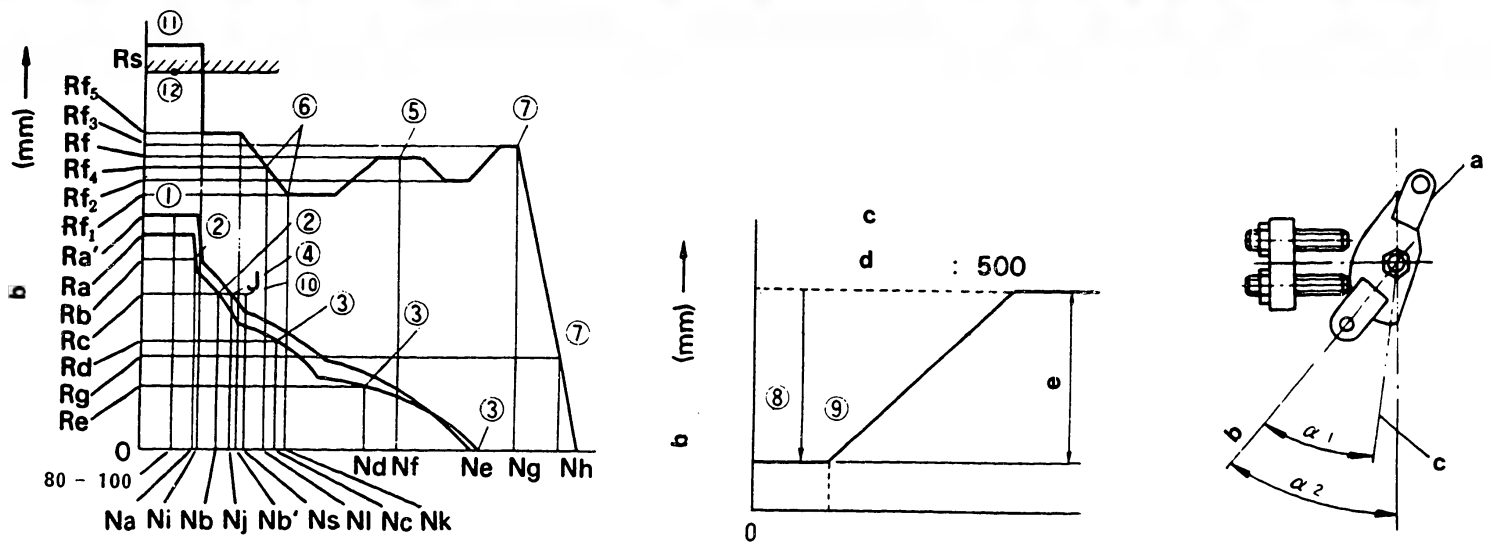


Fig. 138 Governor performance chart

a = Pump speed (rpm)
b = Control rack position

a = Boost pressure
b = Control rack position
c = (When pump speed is not specified)
d = Pump speed: 500 rpm
e = Boost stroke

a = Control lever angle
b = Idling position
c = Full speed position

1. Locking the control rack

   At this time it is necessary to fix the control rack. Normally, injection timing adjustment and fuel injection quantity adjustment are performed before governor adjustment.
   Fix the control rack according to the following procedure:
   Increase the pump speed to 500 – 600 rpm with the control lever held at the idling position, then shift the control lever to the maximum-speed position. Next, set the control rack 3 mm beyond the full-speed position using the full-load setting bolt. Various adjustments can now be made with the control rack locked in the specified position

2. Control lever operation

   Before shifting the control lever to the maximum-speed position, increase the pump speed to 500 – 600 rpm while the control lever is held at the idling position

3. The performance of the governor depends on the engine specifications.

   The performance chart in Fig. 138 is typical of this governor.

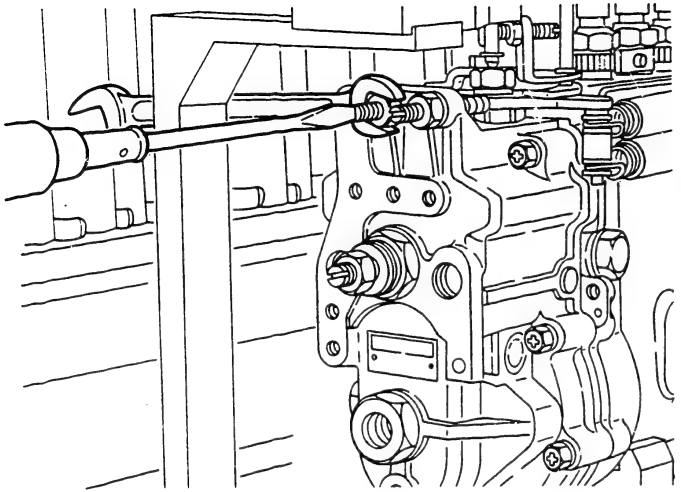


Fig. 139 Temporary setting of the control lever

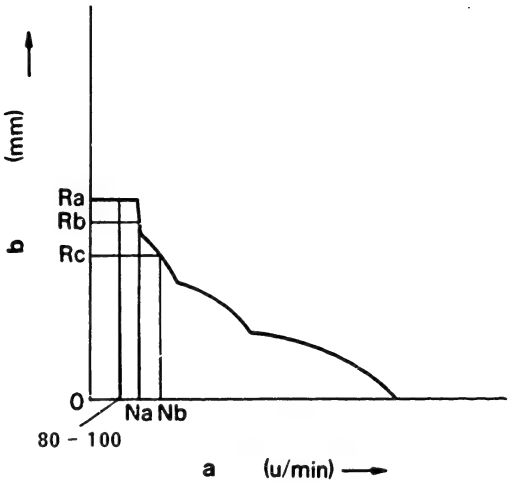


Fig. 140

a = Pump speed (rpm)
b = Control rack position

Idling Adjustment

1. Temporary setting of the control lever.
   While maintaining a pump speed of 80 - 100 rpm, adjust the idling setting bolt (174) (Figs. 139 and 140) so that the control rack will be at position Ra mm.

Note: Ensure the control lever angle is as specified.

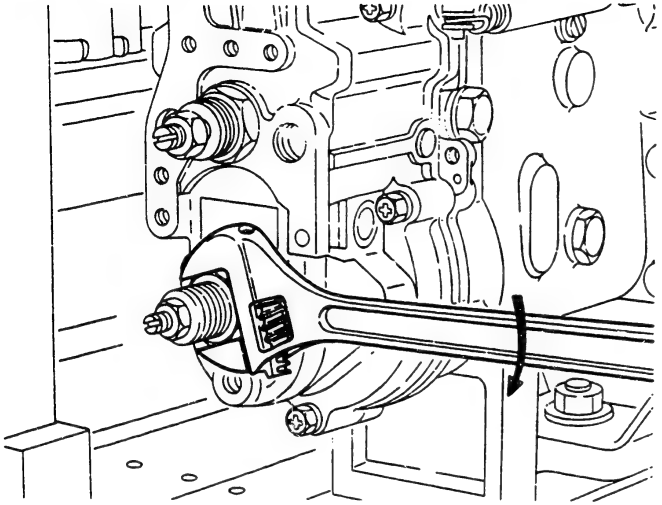


Fig. 141 Adjustment of the outer spring

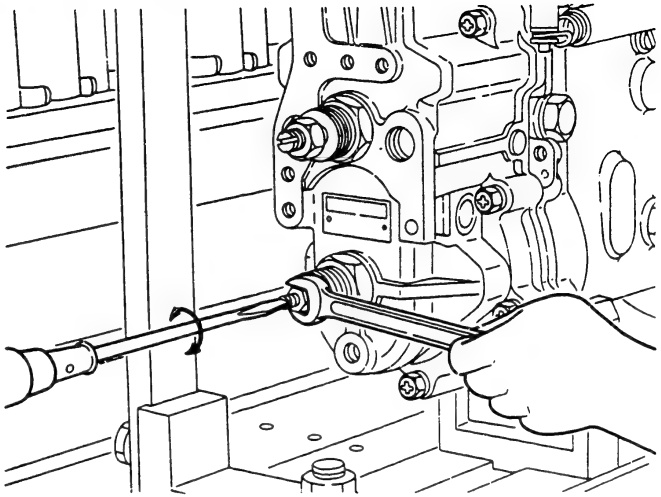


Fig. 142 Adjustment of the inner spring

2. Adjustment of the idling springs

1) Screw in the spring capsule (133) until the control rack is set to position Rb mm with the pump speed increased to Na rpm, and then lock the nut (135). The outer idling spring is now set. (Fig. 141)

2) Adjust the screw (133/2) after increasing the pump speed to Nb rpm so that the control rack will be at Rc mm, and then lock the locking nut (133/5). (Fig. 142)
The inner idling spring is now set.

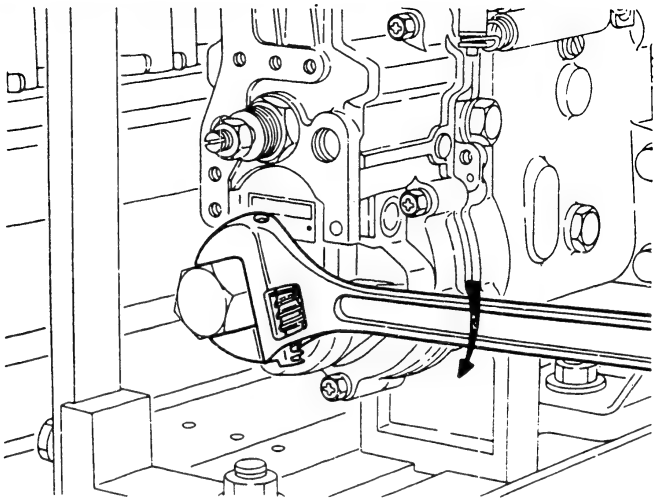


Fig. 143 Fixing the cap

3. Fit the gasket (136) and cap (137) to the spring capsule.

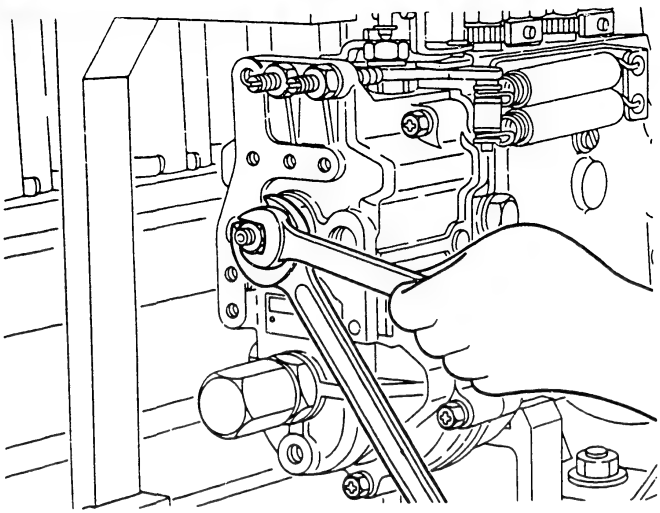


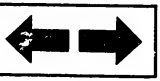
Fig. 144 Adjustment of the governor springs

4. Adjustment of the governor springs

   1) Recheck that the distance between the tip of the guide screw (141) and the outer face of the governor cover is between 13.5 – 14.5 mm. (Fig. 129)

Note: If the distance exceeds 14.5mm, it is difficult to adjust the governor spring with the two nuts (145 and 146). Conversely, when the distance is less than 13.5 mm, the spring seat of the tension lever contacts the guide screw and the flyweight cannot achieve its maximum lift.

2) Lock the control lever at the idling position.



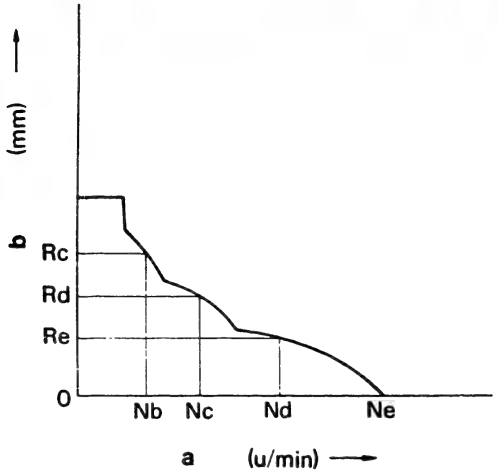


Fig. 145

a = Pump speed (rpm)
b = Control rack position

3) Adjust the nut (145) with the pump speed fixed at Nc rpm so that the control rack will be at position Rd mm, and then lock it to the governor shaft (140) with the nut (146). (Figs. 144 and 145)

4) Increase the pump speed until the control rack position is at Re mm, and then check that the pump speed is Nd rpm. (Fig. 145)

Note: The adjustment sequence may be reversed. (Set to Re mm at Nd rpm, check that speed is Nc rpm at Rd mm)

5) Further increase the pump speed until the control rack reaches position "0" mm and ensure the pump speed is Ne rpm.

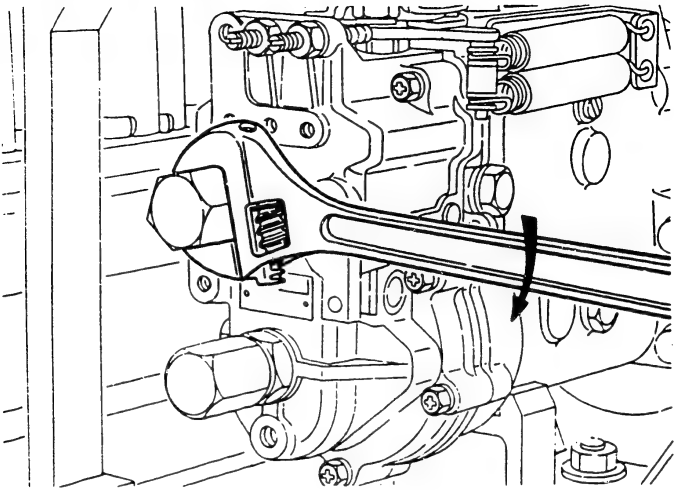


Fig. 146 Fixing the cap

5. Fit both the gasket (148) and cap (149) to the guide screw (141).

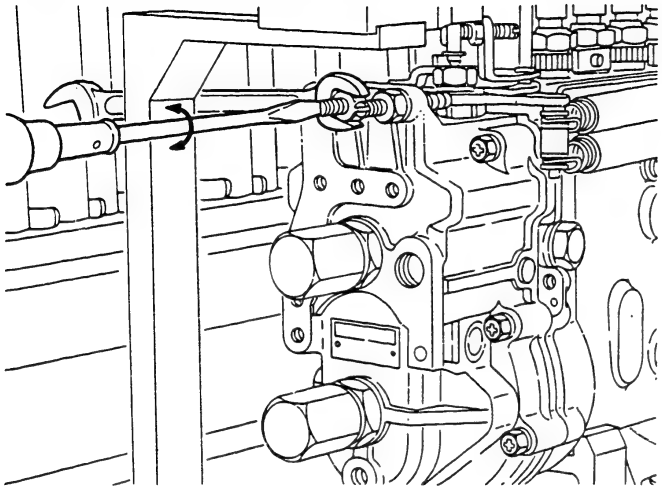


Fig. 147 Adjustment of the idling setting bolt

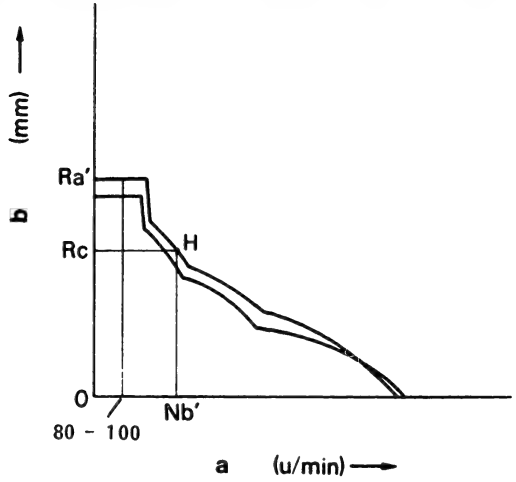


Fig. 148 a = Pump speed (rpm)
b = Control rack position

6. Idling adjustment

1) Decrease the pump speed to Nb' rpm and adjust the idling setting bolt (174) so that the control rack will be at position Rc mm. Then lock the nut (178). (Figs. 147 and 148)

2) Further decrease the pump speed to 80 - 100 rpm, and ensure the control rack is positioned at Ra' mm. (Fig. 148)

3) Check that the control lever angle is as specified with the adjusting device (KDDC 0018).

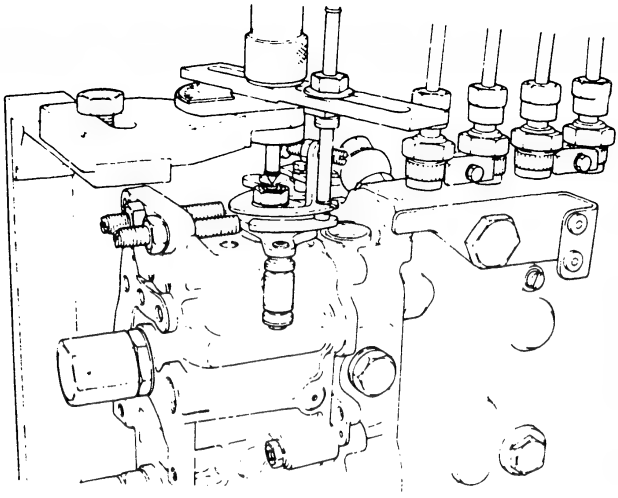


Fig. 149 Temporarily setting the control lever

Full-Load Rack Position Adjustment

When adjusting the boost compensator-equipped governor, perform the full-load rack position adjustment using the values for a boost-compensator equipped governor, as shown in the service data.

1. With the pump speed maintained at Nf rpm, temporarily set the control lever at the position where the lever contacts the maximum-speed setting bolt (175). (Fig. 149)

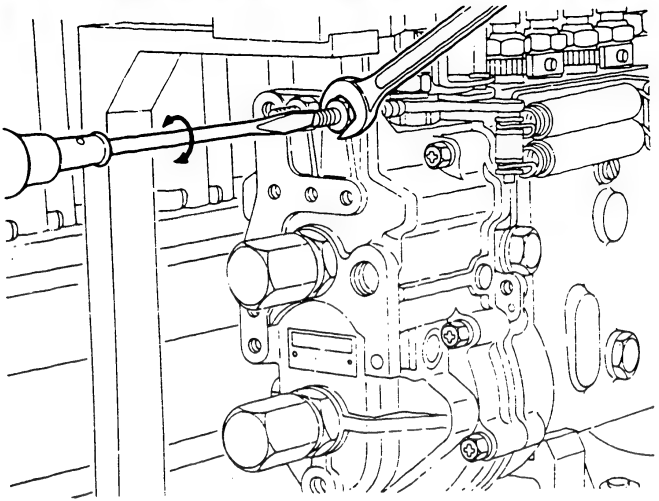


Fig. 150 Adjustment of the maximum-speed setting bolt

2. Adjust the maximum-speed setting bolt so that the control rack begins moving toward the fuel decrease direction at a pump speed of Ng rpm. Then, lock the maximum-speed setting bolt with the nut. (Figs. 150 and 152)

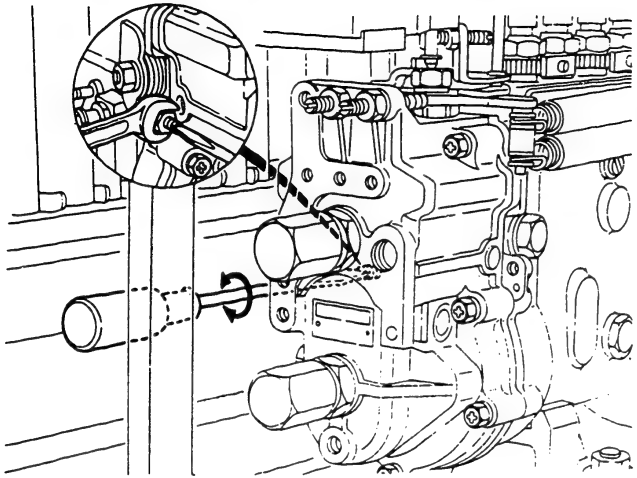


Fig. 151 Adjusting the full-load setting bolt

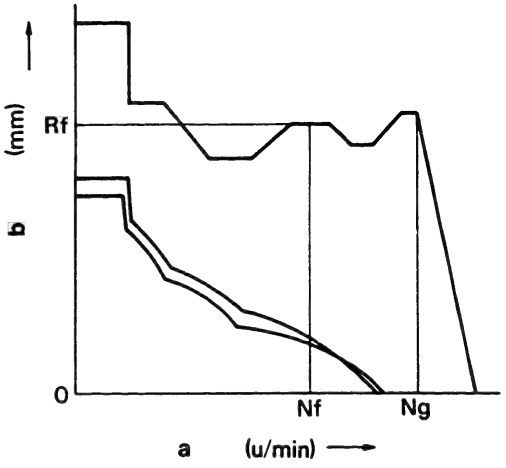


Fig. 152

a = Pump speed (rpm)
b = Control rack position

3. Adjust the full-load setting bolt (173) so that the control rack position is Rf mm when the pump speed is Nf rpm. (Figs 151 and 152)

Note: When the full-load setting bolt is turned clockwise, the control rack position value decreases.

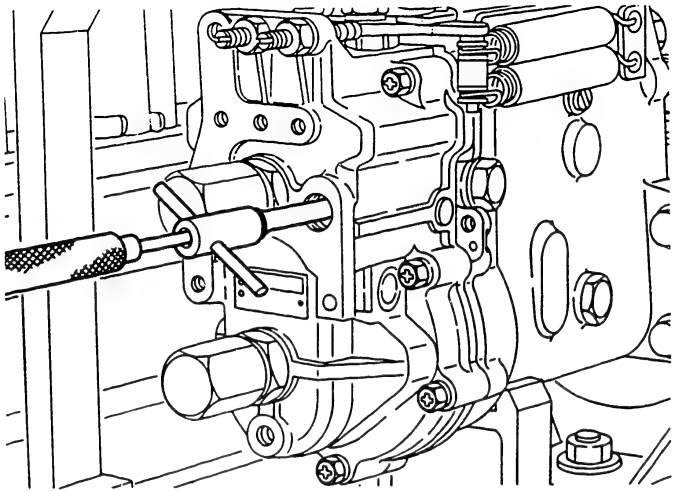


Fig. 153 Adjusting the torque cam position

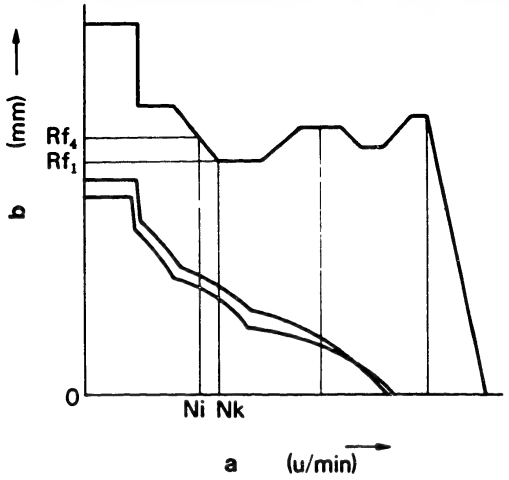


Fig. 154

a = Pump speed (rpm)
b = Control rack position

4. Adjusting the torque cam

1) Using special wrench (SW 7 mm), adjust the adjusting nut (35/4/3) so that the control rack position is Rf_4 mm when the pump speed is Ni rpm.
Lock the adjusting nut with a lock screw (35/4/4). (Figs 153 and 154)

Note: Torque cam adjustment can be performed at a pump speed of either Nk rpm or Ni rpm, whichever is convenient.

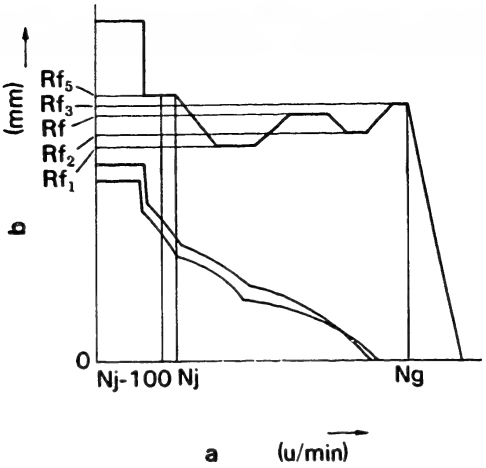


Fig. 155 Checking the torque control stroke

a = Pump speed (rpm)
b = Control rack position

2) Decrease the pump speed to Nj minus approximately 100 rpm, then increase it to Ng rpm to ensure that the torque cam stroke is within the specified range. If the torque cam stroke is not as specified, readjust the full-load setting bolt and torque cam. If this adjustment cannot be performed to obtain the specified control rack position, replace the torque cam. (Fig. 155)

Note: **Before installing a new torque cam, ensure the stamping mark is the same as the number given in the service data.**

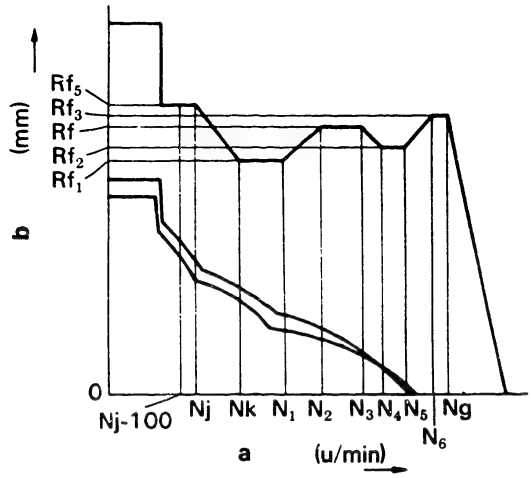


Fig. 156 Checking the specified pump speed

a = Pump speed (rpm)
b = Control rack position

3) Next, increase the pump speed from Nj minus approximately 100 rpm to Ng rpm, then ensure the pump speed is as specified for each control rack position. If the pump speed is not as specified, the torque cam has not been adjusted properly. Readjust it. If the torque cam cannot be adjusted to obtain the specified pump speed, replace the torque cam.

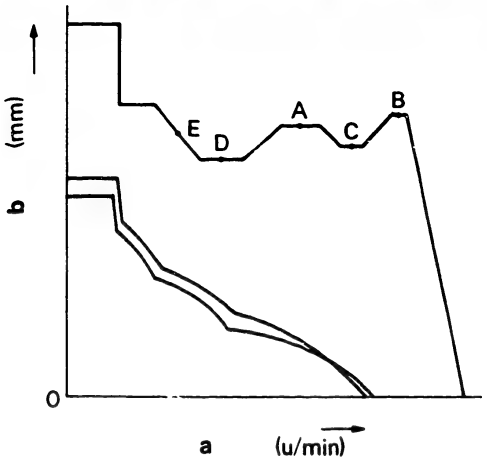


Fig. 157

a = Pump speed (rpm)
b = Control rack position

5. Measure the fuel injection quantity at each of the adjusting points (as specified; ie. the fuel injection characteristics for full-load). If the fuel injection quantity is not as specified, adjust the full-load setting bolt and the torque cam adjusting nut carefully. Lock the nut and bolt after adjustments.

Note: If this adjustment is not executed properly, the specified fuel injection quantity cannot be obtained, there will be decreased engine output and black smoke may be produced.

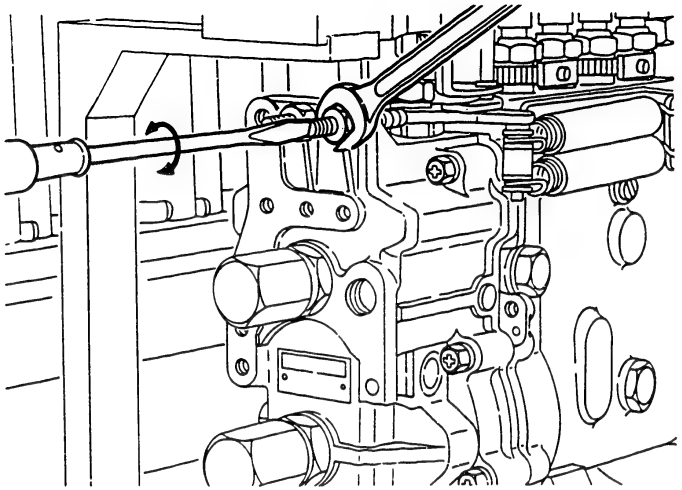


Fig. 158 Adjusting the maximum-speed setting bolt

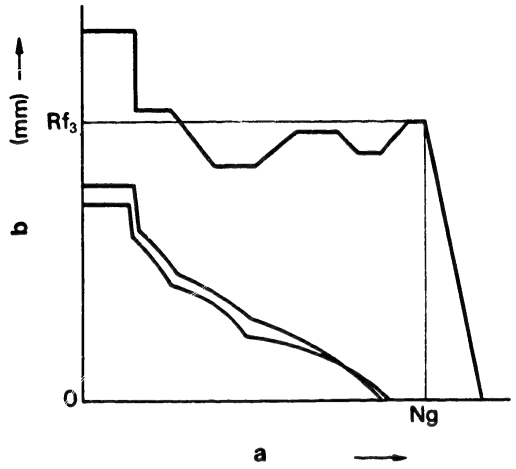


Fig. 159

a = Pump speed (rpm)
b = Control rack position

Maximum-Speed Control Adjustment

1. Lock the control lever when it contacts the maximum-speed setting bolt.
2. With the pump speed maintained at Ng rpm, adjust the maximum-speed setting bolt so that the control rack begins moving from Rf_3 mm in the fuel decrease direction.
   Then, lock the bolt with the nut. (Figs 158 and 159)

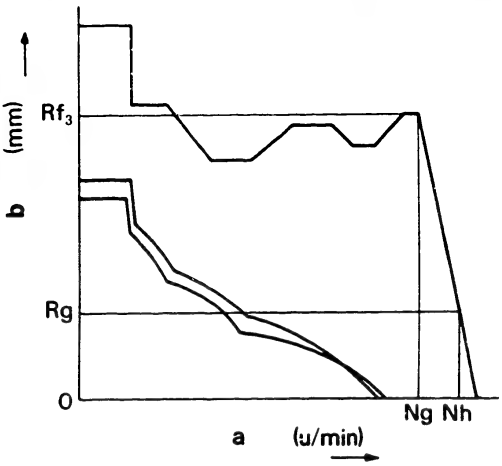


Fig. 160

a = Pump speed (rpm)
b = Control rack position

3. Checking the speed droop
   Gradually increase the pump speed and ensure the pump speed is Nh rpm when the control rack reaches Rg mm. (Fig. 160)

4. Increase the pump speed further to ensure the control rack reaches 0 mm.

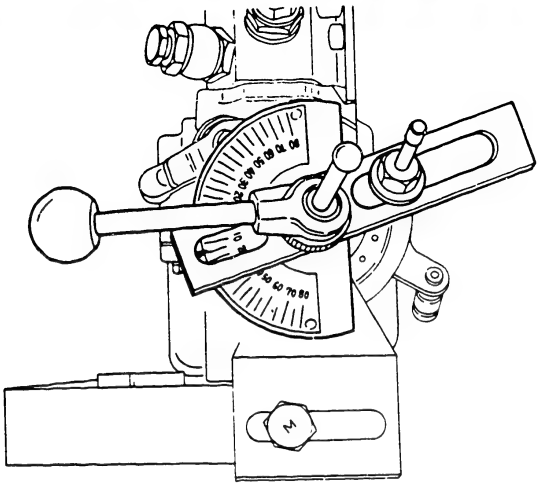


Fig. 161

5. Check that the control lever angle is as specified with the adjusting device (KDDC 0018).

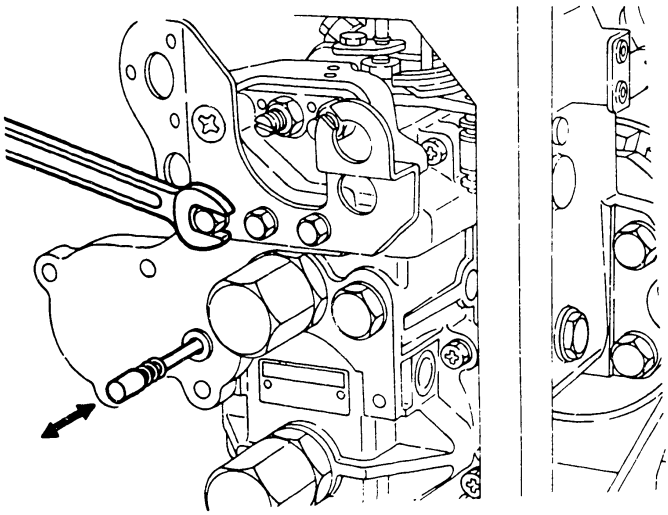


Fig. 162 Checking pushrod movement

Boost Compensator Adjustment (when installed)

If the governor does not have a boost compensator, proceed to "confirmation of the excess fuel limit for engine starting".

1. Install the spacer (1A) on the governor cover, and ensure the pushrod can move smoothly. (Fig. 162)

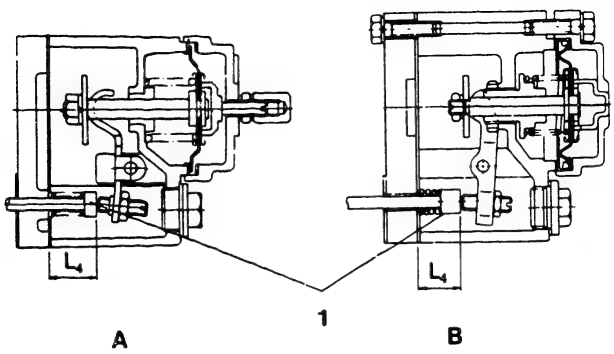


Fig. 163 Checking pushrod protrusion

1 = Pushrod B

A = Improved-type boost compensator
L_4 = 23.95 to 24.05 mm

B = Conventional-type boost compensator
L_4 = 19.4 to 19.6 mm

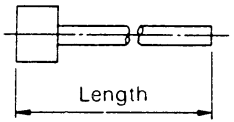
2. Checking pushrod protrusion

   1) Fix the control lever in the maximum-speed position.

2) Operate the injection pump at the specified speed, marked BASIC in the injection quantity table of the injection pump calibration data (usually adjusting point A).

3) In this condition, use calipers to measure the protrusion (dimension L) of pushrod B from the end face of the spacer. If dimension L is not within the specified range, replace pushrod B so that L is as specified. (Fig. 163)

Pushrod table

* Part No	Length (mm)	* Part No.	Length (mm)	Remarks
159274-0120	125	159274-1620	122	
159274-0220	127.5	159274-1720	122.5	
159274-0320	128	159274-1820	123	
159274-0420	127	159274-1920	123.5	
159274-0520	126	159274-4220	129.5	
159274-0620	129	159274-4320	130	
159274-0720	128.5	159274-4420	130.5	
159274-0820	125.5	159274-4520	131	
159274-0920	126.5	159274-4620	131.5	
159274-1120	119.5	159274-4720	132	
159274-1220	120	159274-4820	132.5	
159274-1320	120.5	159274-4920	133	
159274-1420	121	159274-5020	133.5	
159274-1520	121.5			

* Bosch Nr., see cross reference DKKC - Bosch, microfiche HB 30, HB 31

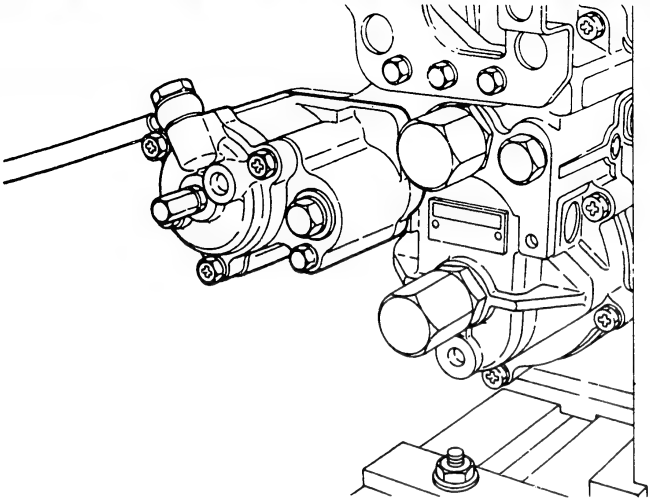


Fig. 164 Mounting the boost compensator

3. Install the boost compensator assembly, then attach the compressed-air pipe.

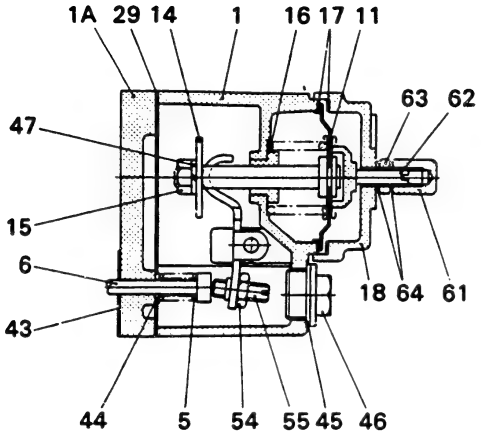


Fig. 165 Cross-sectional view of the boost compensator

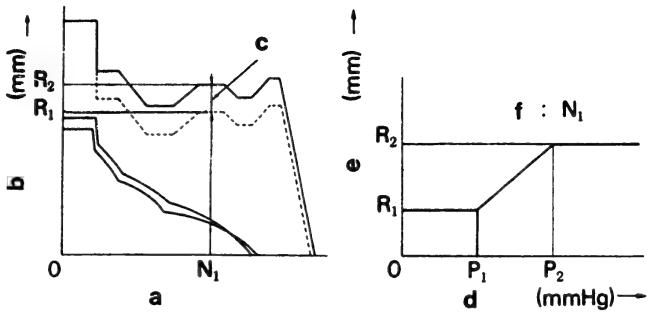


Fig. 166

a = Pump speed (rpm)
b = Control rack position
c = Boost compensator stroke
d = Boost pressure
e = Control rack position
f = Pump speed N_1 rpm

4. Boost compensator stroke adjustment

1) Confirm that the screw (62) position is the same as that before disassembly.
2) Remove the plug (46) and gasket (45).
3) Maintain the pump speed at N_1 rpm.
4) Fully loosen the screw (55) with the wrench (KDEP 2605), and then confirm that the control rack position R_2 mm can be obtained. If the control rack position R_2 is not as specified, readjust the full-load setting bolt and torque cam.

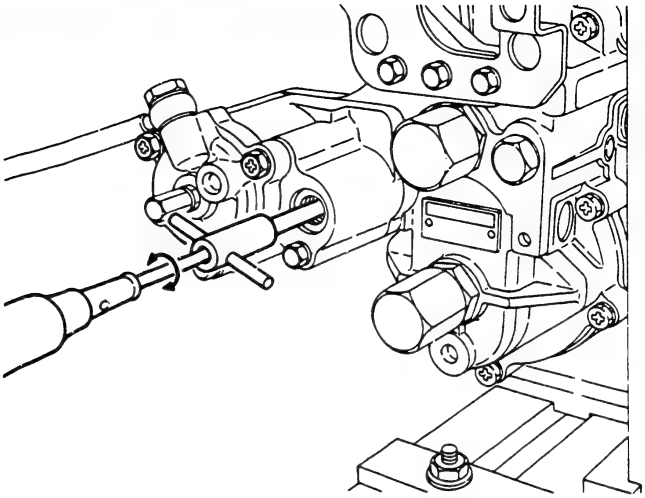


Fig. 167 Adjustment of the boost compensator stroke

5) Shift the control rack position from R_2 mm to R_1 mm using the screw (55), and then lock it with the nut (54).
(Figs. 166 and 167)

Note: During boost compensator stroke adjustment it is not necessary to supply compressed air.

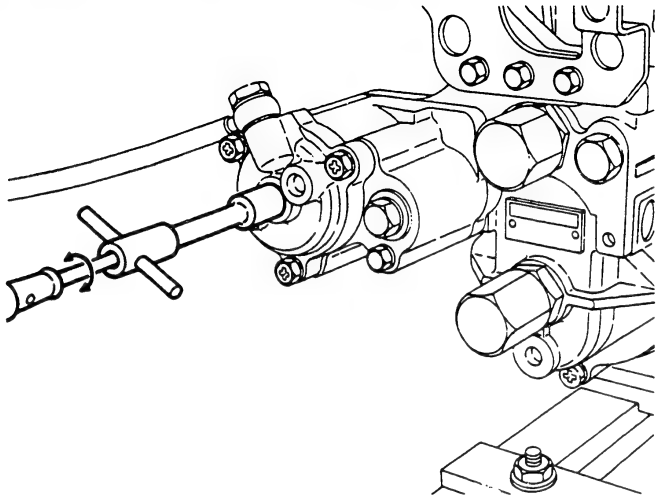


Fig. 168 Setting the boost compensator spring force

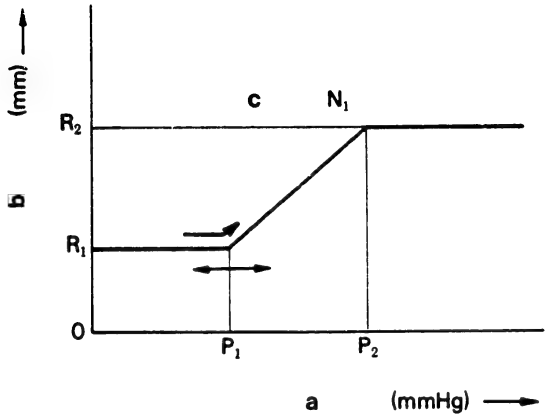


Fig. 169

a = Boost pressure
b = Control rack position
c = Pump speed N_1 rpm

5. Setting the boost compensator spring force

1) With the pump speed maintained at N_1 rpm, gradually increase the boost pressure.

2) Adjust the screw (62) so that the control rack begins moving from R_1 mm in the fuel increase direction when the boost pressure reaches P_1 mmHg.
Lock the screw with the nut (63). (Figs. 168 and 169)

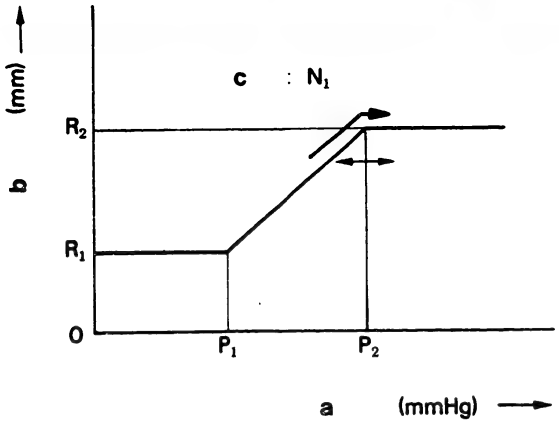


Fig. 170

a = Boost pressure
b = Control rack position
c = Pump speed N_1 rpm

3) Increase the boost pressure, and ensure it reaches P_2 mmHg when the control rack is at R_2 mm. If the boost pressure is not as specified, replace the boost compensator spring (16). (Fig. 170)

4) Recheck the boost compensator stroke, and if not as specified readjust the screw (55).

Aneroid Compensator Adjustment (when installed)

If the governor does not have an aneroid compensator, proceed to "confirmation of the excess fuel limit for engine starting"

The following describes the procedure for adjusting the RLD type governor equipped with an aneroid compensator.
This section explains only the adjustment procedure of the aneroid compensator.

Caution: **The aneroid compensator must be adjusted at sea level.**

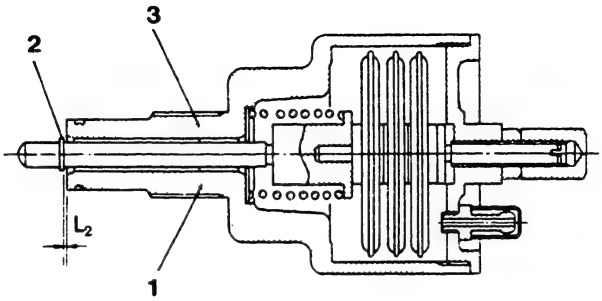


Fig. 171 Assembled dimensions of aneroid compensator

1 = Pushrod (1)
2 = Snapring
3 = Housing

Standard Type Aneroid Compensator

1. Aneroid compensator inspection
   Measure the distance (dimension L_2) between the snapring assembled with pushrod (1) and the housing. (Fig. 171)

If dimension L_2 is outside the specified range, adjust using the set screw after removing the aneroid compensator capnut and loosening the locknut.

2. Checking pushrod protrusion
   Check the following items before attaching the spacer to the governor cover.

   1) Fix the speed control lever in the maximum speed position. Next, operate the injection pump at the specified speed.

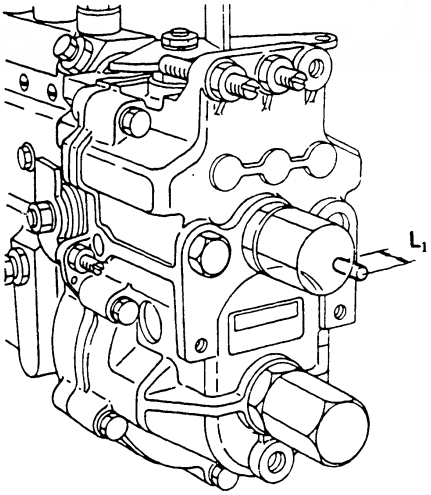


Fig. 172 Pushrod protrusion

2) In this condition, use calipers to measure the protrusion (dimension L_1) of pushrod (2) from the end face of the governor cover when the specified control rack position is obtained. (Fig. 172)
If dimension L_1 is not within the specified range, replace pushrod (2) so that L_1 is as specified.

3. Adjustment after aneroid compensator assembly
Secure the control lever at the maximum speed position and operate the injection pump at the specified speed.

Pushrod (2) specification table

* Part No.	Length (mm)	Shape
155423-1200	102.0	
155423-1300	102.5	
155423-1400	103.0	
155423-7600	103.5	
155423-7700	104.0	
155423-8700	97.0	
155423-8800	98.0	
155423-8900	99.0	
155423-9000	100.0	
155423-9100	101.0	

* Bosch Nr., see cross reference DKKC - Bosch, microfiche HB 30, HB 31

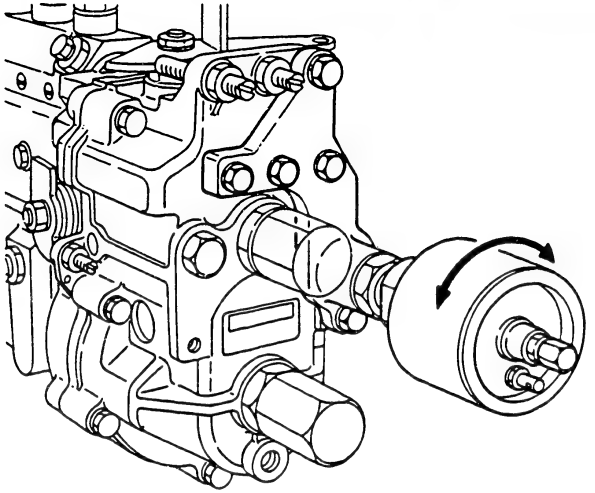


Fig. 173 Adjusting control rack position

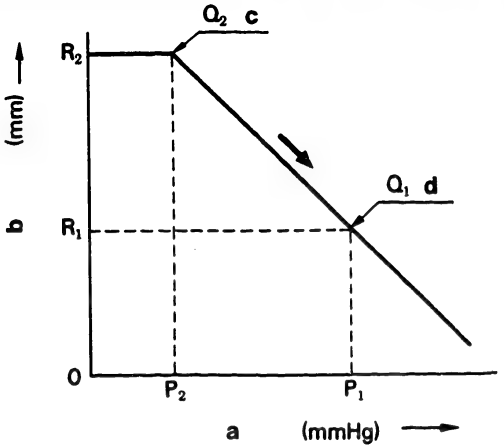


Fig. 174 Characteristic curve of aneroid compensator

a = Negative pressure
b = Control rack position
c = Q_2 cc/1000 st
d = Q_1 cc/1000 st

1) In this condition, "supply negative pressure"* P_1 mmHg to the aneroid compensator' s atmospheric chamber.
Rotate the aneroid compensator housing to adjust the control rack position to R_1 mm.
Check that fuel injection quantity Q_1 cc/1000 st is obtained at this point. (Figs. 173 and 174)

2) Next, decrease the negative pressure of the aneroid compensator' s atmospheric chamber to less than P_2 mmHg, and then increase to P_2 mmHg and check that the control rack position is R_2 mm.
Check that fuel injection quantity Q_2 cc/1000 st is obtained at this point. Always measure the negative pressure in an increase direction (direction of the arrow). (Fig. 174)

*Note: The following explains the relationship between negative pressure as shown in Fig. 174 and absolute pressure.

Zero point (ie. the intersection of the axes) in Fig. 174 equals absolute pressure at sea level (760 mmHg).

In relation to the negative pressure for example, the change from O to P_1 mmHg on the horizontal axis in Fig. 174 is an increase in negative pressure.

However, in terms of absolute pressure, the above equals a reduction in absolute pressure from 760 mmHg to the point 760 mmHg $-$ P_1 mmHg.

In other words, an increase in the negative pressure is actually a decrease in absolute pressure. "Supply negative pressure" means "reduce the pressure".

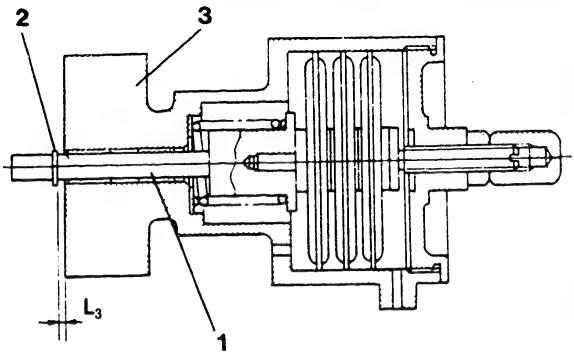


Fig. 175 Assembled dimensions of aneroid compensator

1 = Pushrod (1)
2 = Snapring
3 = Housing

"Inverted Type"Aneroid Compensator

1. Aneroid compensator inspection
   Measure the distance (dimension L_3) between the snapring assembled with pushrod (1) and the housing. (Fig. 175) If dimension L_3 is outside the specified range, adjust using the setscrew after removing the aneroid compensator capnut and loosening the locknut.

2. Checking pushrod (2) protrusion

   1) Fix the control lever in the maximum speed position. Next, operate the injection pump at the specified speed.

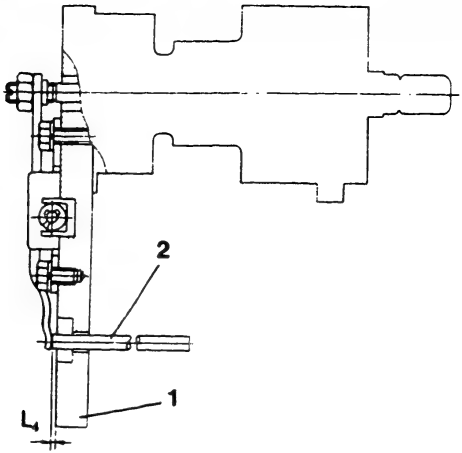


Fig. 176 Checking pushrod (2) protrusion

1 = Spacer
2 = Pushrod (2)

2) With the spacer installed on the governor cover, check that the protrusion of pushrod (2) from the spacer (dimension L_4) is as specified. (Fig. 176)

   If dimension L_4 is outside the specified range, replace pushrod (2) and readjust L_4 so that it is as specified.
   For details of the part numbers and specifications of pushrod (2), refer to the pushrod (2) specification table.

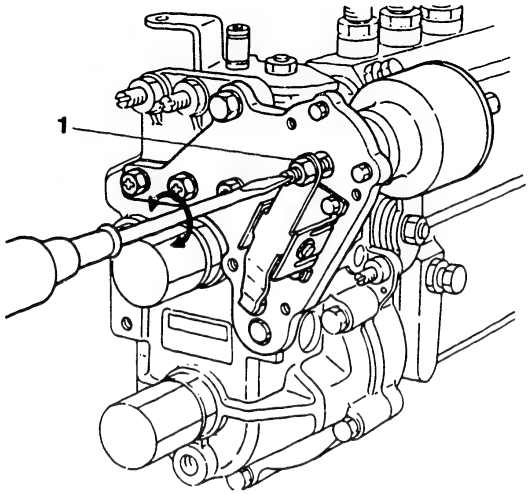


Fig. 177 Adjustment of control rack position

1 = Adjustment screw

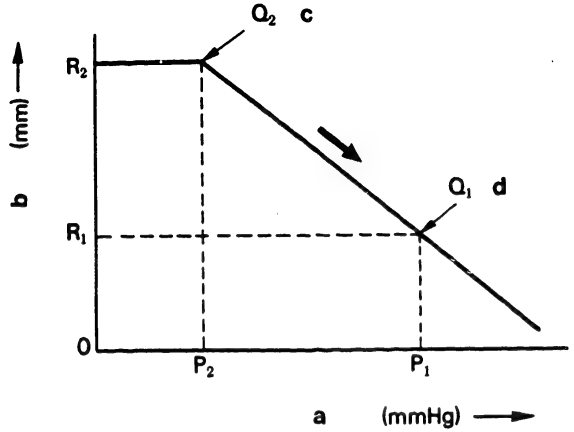


Fig. 178 Characteristic curve of aneroid compensator

a = Negative pressure
b = Control rack position
c = Q_2 cc/1000 st
d = Q_1 cc/1000 st

3. Adjustment after aneroid compensator assembly
Secure the speed control lever at the maximum speed position and operate the injection pump at the specified speed.

1) Supply negative pressure P_1 mmHg and adjust using the adjusting screw so that the control rack position is R_1 mm. Check that fuel injection quantity Q_1 cc/1000 st is obtained at this point. (Figs. 177 and 178)

2) Next, supply negative pressure P_2 mmHg and check that the control rack position is R_2 mm. Check that fuel injection quantity Q_2 cc/1000 st is obtained at this point.
Always measure the negative pressure in an increase direction (direction of the arrow).

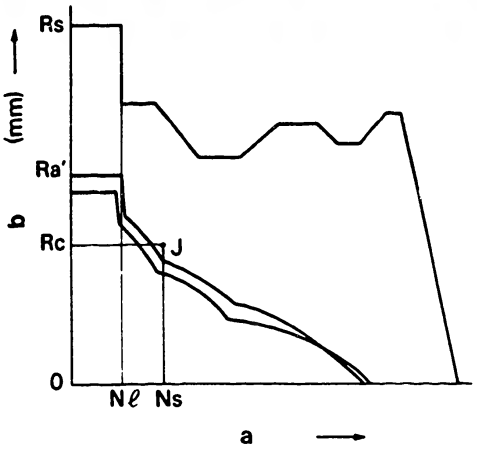


Fig. 179

a = Pump speed (rpm)
b = Control rack position

Confirming the Excess Fuel Limit for Engine Starting

1. With the pump speed maintained at Ns rpm, lock the control lever when the control rack position is Rc mm (point J in Fig. 179).

2. Ensure the control rack moves beyond Ra' mm when the pump speed is reduced to 0 rpm.
3. Maintaining a pump speed of less than Nℓ rpm, ensure the control rack moves beyond Rs mm when the control lever is shifted toward the maximum-speed position.

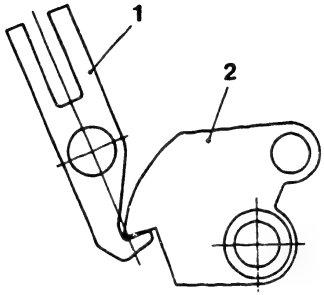


Fig. 180

1 = Sensor lever
2 = Torque cam

The above confirmation ensures that the sensor lever and torque cam are positioned as shown in Fig. 180 when the control rack moves beyond Rs mm.

Note: 1. The control rack must not move to Rs mm if the pump speed is decreased to N ℓ rpm with the control lever locked at the maximum-speed position

2. If control rack positions Ra' and Rs mm are not indicated in the calibration data, confirmation of the excess fuel limit is unnecessary.

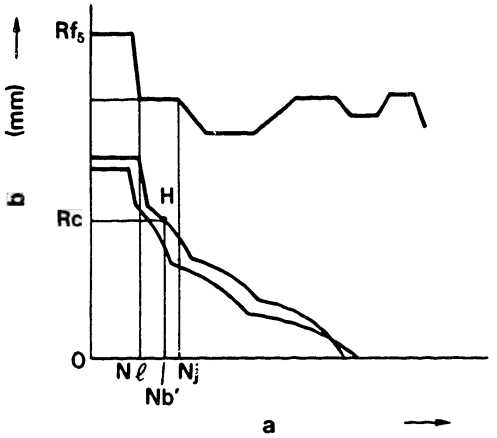


Fig. 181 a = Pump speed (rpm)
b = Control rack position

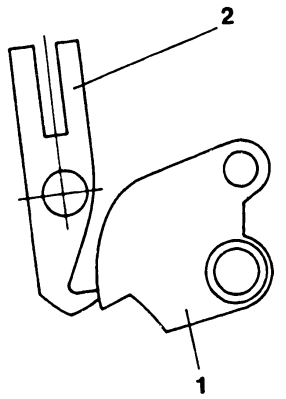


Fig. 182 1 = Torque cam
2 = Sensor lever

Confirming the Black Smoke Limit

1. With the pump speed maintained above Nℓ (i.e. Nb') rpm, fix the control lever at the idling position.
2. Ensure the control rack does not move beyond Rf_5 mm when the control lever is shifted toward the maximum-speed position. (Fig. 181)
3. Keep the control lever at the maximum-speed position and gradually increase the pump speed.
4. Confirm that the control rack begins moving from Rf_5 mm in the fuel decrease direction when the pump speed exceeds Nj rpm.

The above confirmation ensures that the sensor lever and torque cam are as shown in Fig. 182 when the control lever is shifted toward the maximum-speed position during engine operation.

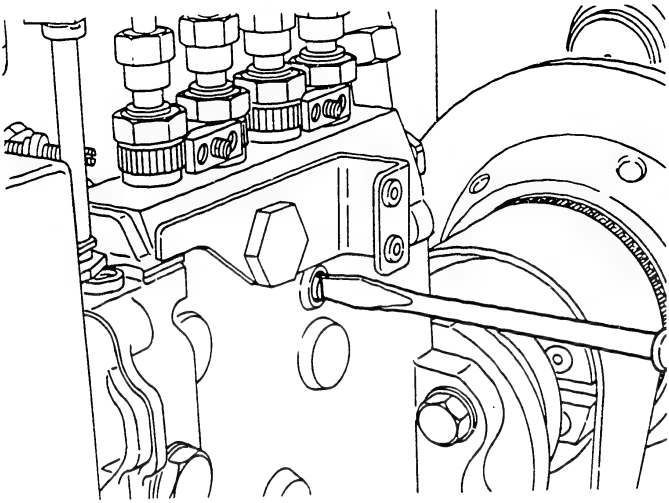


Fig. 183 Removal of the rack guide screw

Control Rack Limiter Adjustment

Screw type

1. Remove the rack guide screw from the pump housing.

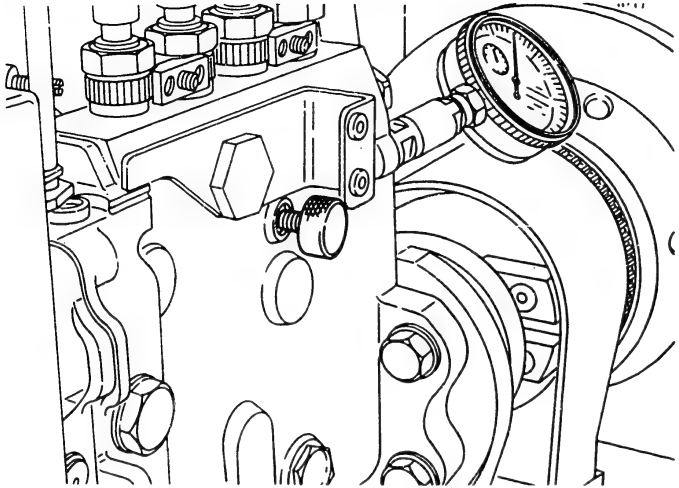


Fig. 184 Locking the control rack

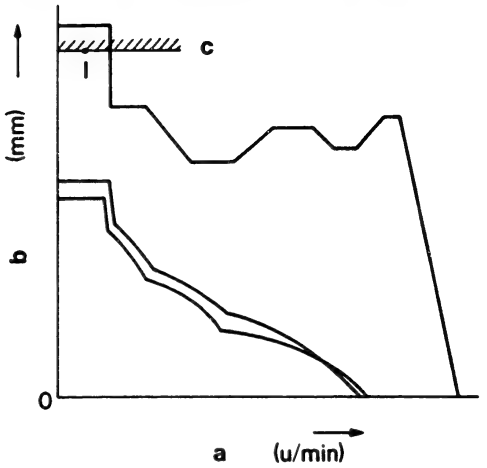


Fig. 185

a = Pump speed (rpm)
b = Control rack position
c = Rack limit

2. Using a screw lock the control rack at the position given with the calibration data, maintaining the pump speed at 0 rpm. (Figs. 184 and 185)

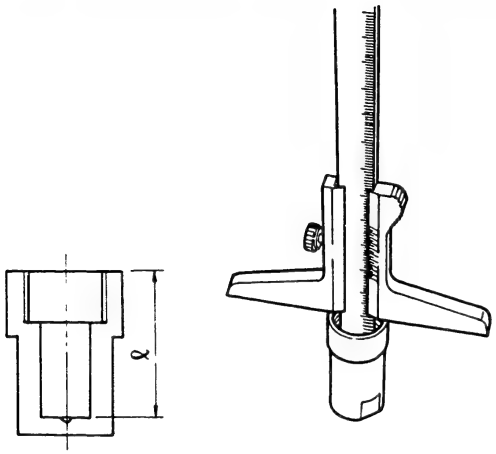


Fig. 186

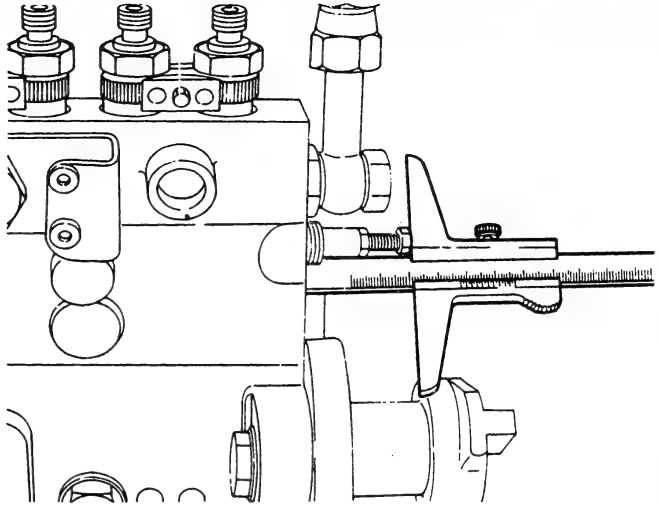


Fig. 187 Measuring the distance "ℓ"

3. Measure the depth "ℓ" of the rack cap (65). (Fig. 186)
4. Attach both the bolt and nut to the end of the control rack.
5. Adjust the bolt so that the distance between the end face of the pump housing and the bolt top is "ℓ", i.e. the rack cap depth.

   Tighten the nut to lock the bolt. (Fig. 187)

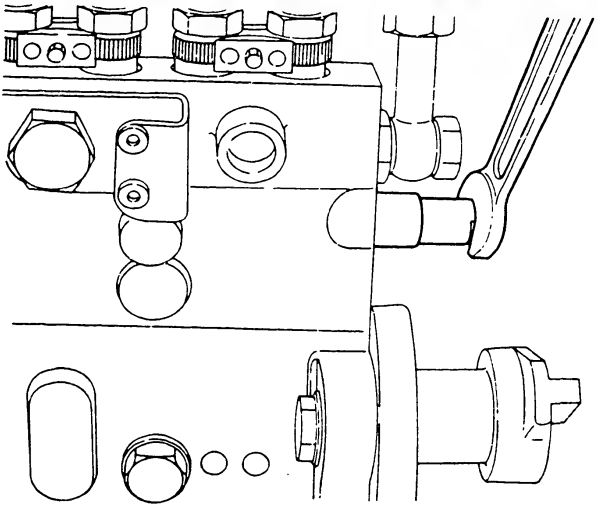


Fig. 188 Installing the rack cap

6. Install the rack cap.

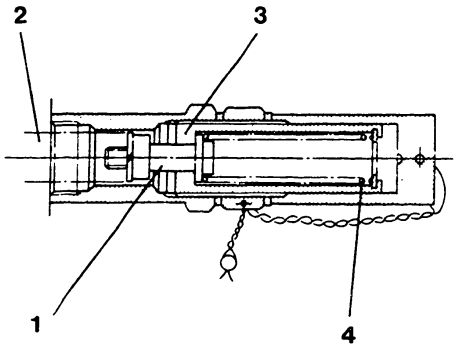


Fig. 189

1 = Pushrod
2 = Control rack
3 = Spring capsule
4 = Spring

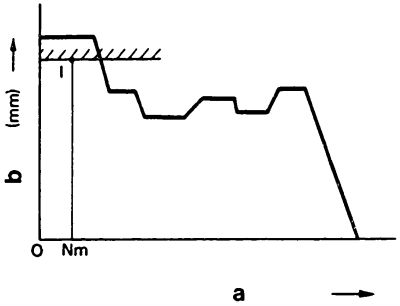


Fig. 190

a = Pump speed (rpm)
b = Control rack position

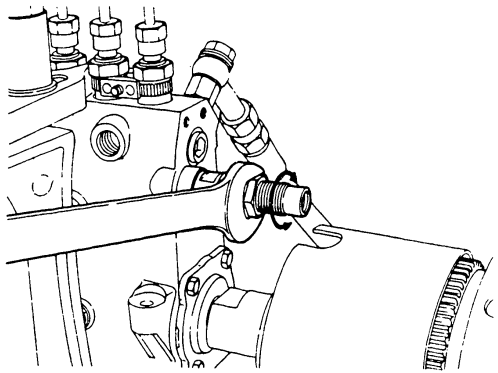


Fig. 191 Adjusting the smoke limiter

Spring Type

1. Fix the control lever at the maximum-speed position.
2. Maintain the pump speed at Nm rpm. (Fig. 190)
3. Attach the smoke limiter to the control rack tip. (Fig. 189)
4. Adjust the smoke limiter spring capsule so that the fuel injection quantity for "engine start" at point I is as specified in the calibration data. (Figs. 190 and 191)
5. Install the gasket and capnut.

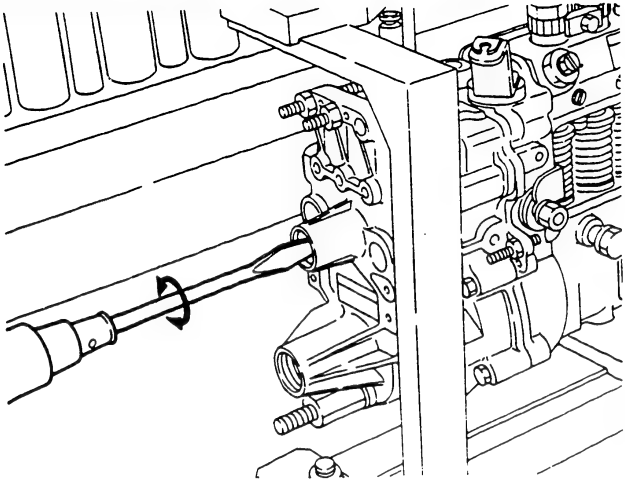


Fig. 192

RLD-E Type Governor Adjustment

The adjustment procedure for the RLD-E type governor differs from that of the RLD-A type governor. Adjustment is explained below only where parts differ from those of the RLD-A type governor.

1. Setting the control rack's "0" position

    1) Screw in the governor shaft fully, and hold the control lever at the idling position. (Fig. 192)

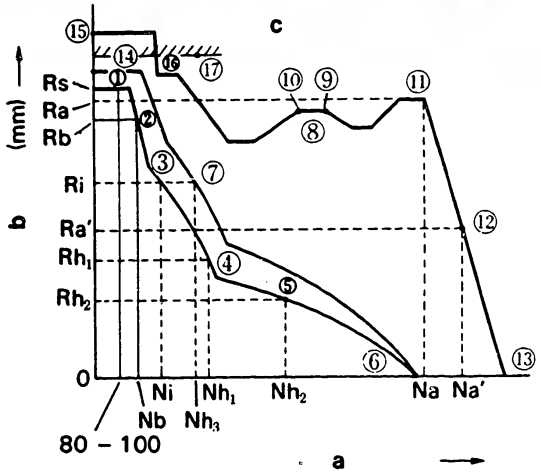


Fig. 193

a = Pump speed (rpm)
b = Control rack position
c = The figures in circles show the order for adjusting and checking

2) Raise the pump speed gradually until it reaches point (6), where the governor spring stops operating. Then, push the rack fully in the "fuel decrease" direction. The position where it stops moving is the control rack's "0" position.

3) Set the indicator of the measuring device's dial gauge to "0".

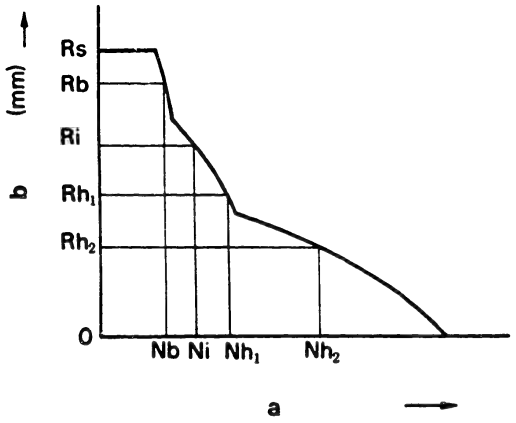


Fig. 194

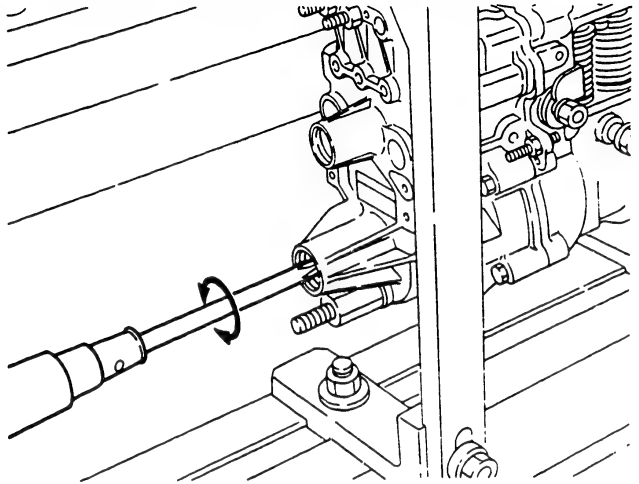


Fig. 195 Adjusting the idling spring assembly

a = Pump speed (rpm)
b = Control rack position

2. Idling spring adjustment

1) With the pump speed maintained at 80 - 100 rpm, temporarily set the control lever so that the control rack position is Rs mm, the same as for the conventional type RLD governor. (Fig. 194)

2) Maintain pump speed at Nb rpm and screw in the idling spring assembly. When the rack position is Rb mm, tighten the locknut.

Tightening torque: 2.5 - 3 kg-m (Figs. 194 and 195)

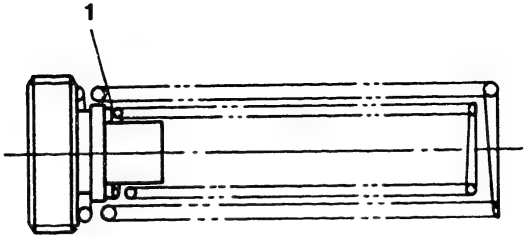


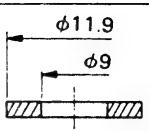
Fig. 196 Idling spring assembly

1 = Shim

3) Increase the pump speed until the control rack position is at Ri mm and then check that the pump speed is Ni rpm. (Fig. 194)

Note: If the pump speed Ni rpm is not as specified, adjust by altering the shim thickness.

Adjusting shims

* Part No.	Thickness (mm)	Remarks
029310-9240 029310-9250 029310-9260 029310-9270	0.10 0.20 0.25 1.00	 Unit: mm

* Bosch Nr., see cross reference DKKC - Bosch, microfiche HB 30, HB 31

3. Adjustment of the governor springs

   1) Unlike the RLD-A type governor, there is no guide screw, and so it is unnecessary to adjust to L = 14 ± 0.05 mm.

   2) Maintain pump speed at Nh_1 rpm and adjust the amount the governor shaft is screwed in (tightening torque of nut: 1.0 – 1.5 kg-m) so that the rack position is Rh_1 mm. (Figs. 194 and 197)

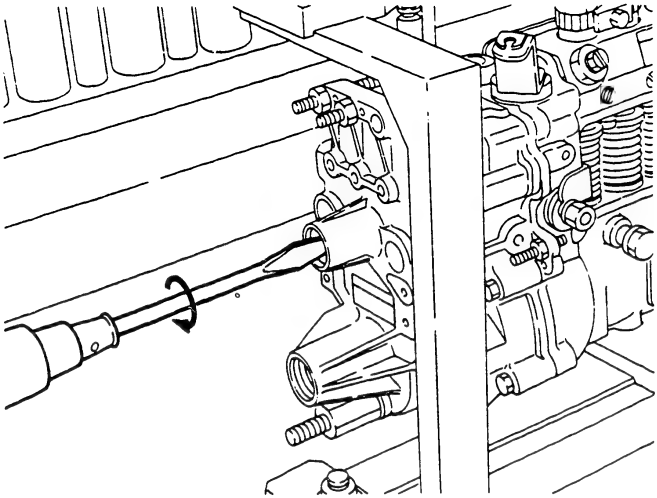


Fig. 197 Adjusting the governor shaft

3) Check that the control rack position is Rh_2 mm when the pump speed is Nh_2 rpm. If it is not as specified, replace the governor springs with new ones.
The above points differ from the RLD type governors.

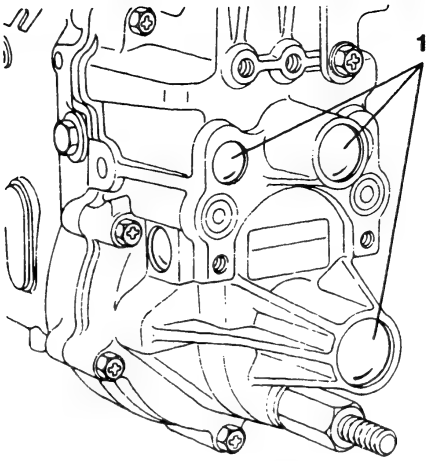


Fig. 198 Plate plugs

1 = Plate plugs

4. Installation of plate plugs
   After adjusting the governor, check that there is no damage to the inside surfaces where the governor cover plates are press fitted. In addition, remove as much oil as possible from inside.

   1) Push in new plate plugs with a finger, and drive them securely into place with the special press-fitting rods **(KDEP 2631, KDEP 2632, KDEP 2633).**

   2) After press-fitting each plug, thoroughly coat the outside surface with adhesive (Three Bond No. 1405D).

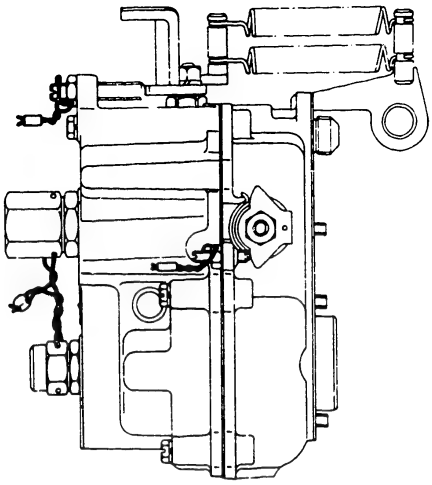


Fig. 199

HANDLING

Lock-Sealing

All adjusting stoppers (bolts, nuts, screws) that directly affect engine performance are lock-sealed after adjustment. Do not readjust any stopper without using the pump test stand or the engine test bench, as this will adversely effect the engine, which will then be unable to operate at peak performance. In addition the engine may overrun or overheat, causing damage.

Lubricating Oil

The interior mechanism of the governor chamber and injection pump cam chamber are lubricated with engine oil delivered by the oil pump. To assure the normal performance of the injection pump assembly for an extended period, it is vital to check engine oil carefully and often, and to replace oil regularly at the intervals specified by the engine manufacturer.

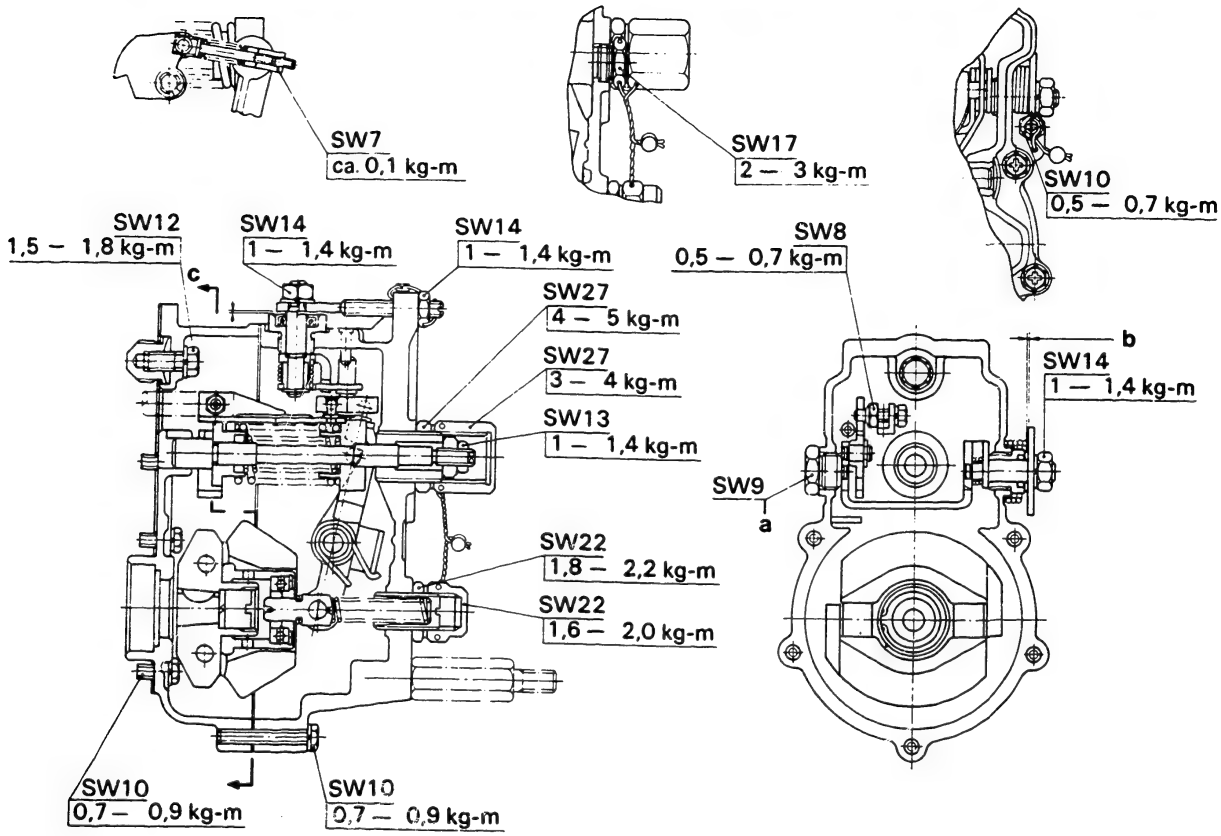


Fig. 200 TIGHTENING TORQUE

a = Before fastening, apply liquid adhesive
b
c = Clearance: less than 0.1

Note: SW 10 means that the width across flats of a bolt (nut) is 10 mm.

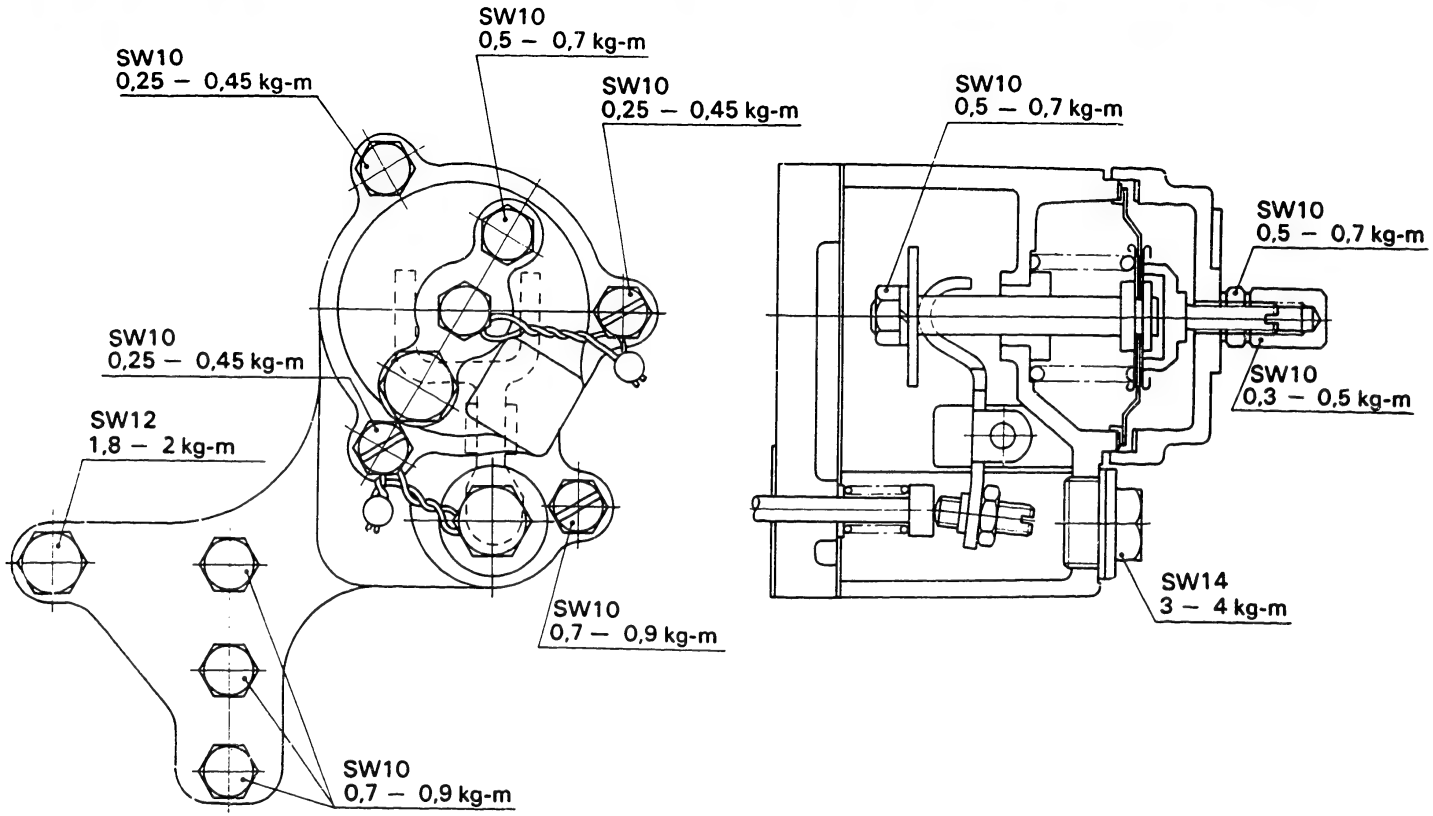


Fig. 200-1 Tightening torque

Note: SW 10 means that the width across flats of a bolt (nut) is 10 mm.

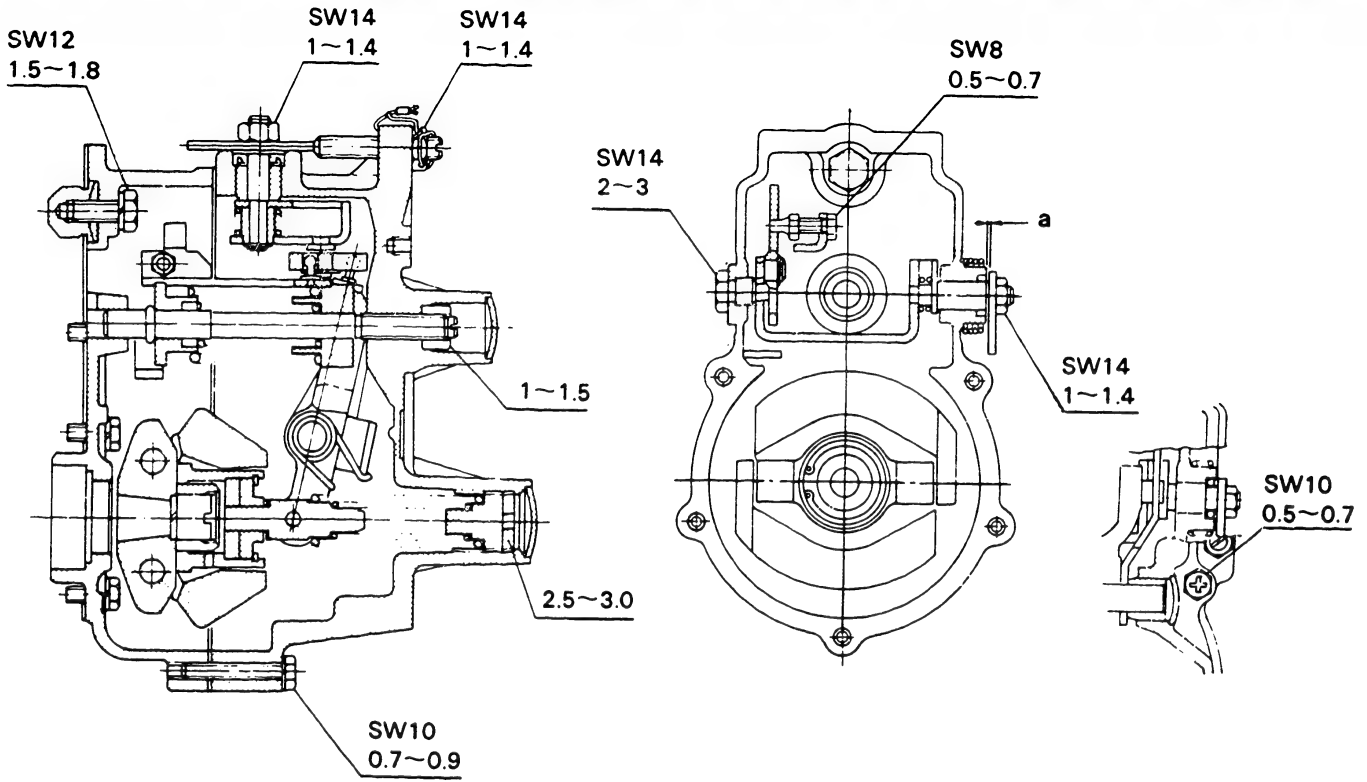


Fig. 200-2 RLD-E type governor

a = Clearance: less than 0.1 mm

Tightening Torque

Code Number

(example) 1 0 5 9 3 1 - 0 9 3 0
(1) (2) (3) (4) (5)

(1) RLD mechanical governor
(2) Governor installation position
2 ..... right side
3 ..... left side

(3) Additional devices
0 ..... without torque cam
1 ..... with torque cam

(4) Specific number
(5) Modification code

Bosch Type Number

(example) N P - E P / R L D 3 0 0 ~ 1 8 5 0 A 2 C K L N1
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12)

(1) Manufactured by Z E X E L
(2) For injection pump
(3) RLD model mechanical governor, manufactured by Z E X E L
(4) Governor low-speed limit (rpm)
(5) Control method
/: Minimum-maximum speed
~: Variable speed
(6) Governor high-speed limit (rpm)
(7) Applicable injection pump size
A ..... PE-A (D) model pump

(8) Weight of flyweight
- 1: 740g
- 2: 640g
- 3: 540g

(9) Governor type
- A ..... RLD-A type governor
- B ..... RLD-B type governor
- C ..... RLD-C type governor
- E ..... RLD-E type governor

(10) Additional functions (main)
- O ..... no additional functions
- K ..... with torque cam
- F ..... with torque cam and stopping device
- M ..... with torque cam and boost compensator
- U ..... with torque cam and aneroid compensator
- X ..... with torque cam, boost compensator and stopping device

(11) Installation position
- R ..... pump fitted at right side
- L ..... pump fitted at left side

(12) Modification code

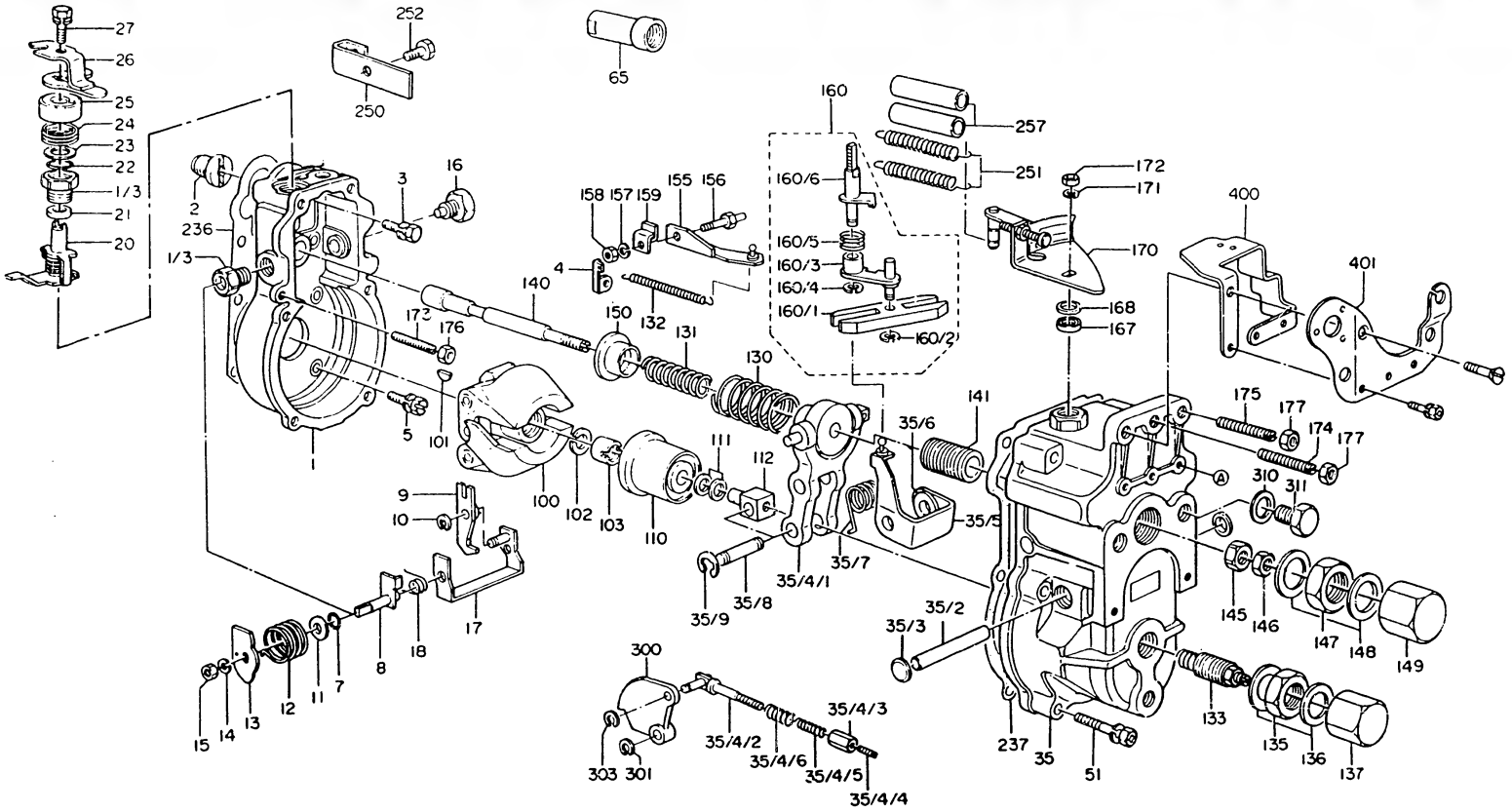


Fig. 201

EXPLODED VIEW OF THE BOOST COMPENSATOR-EQUIPPED RLD-A GOVERNOR

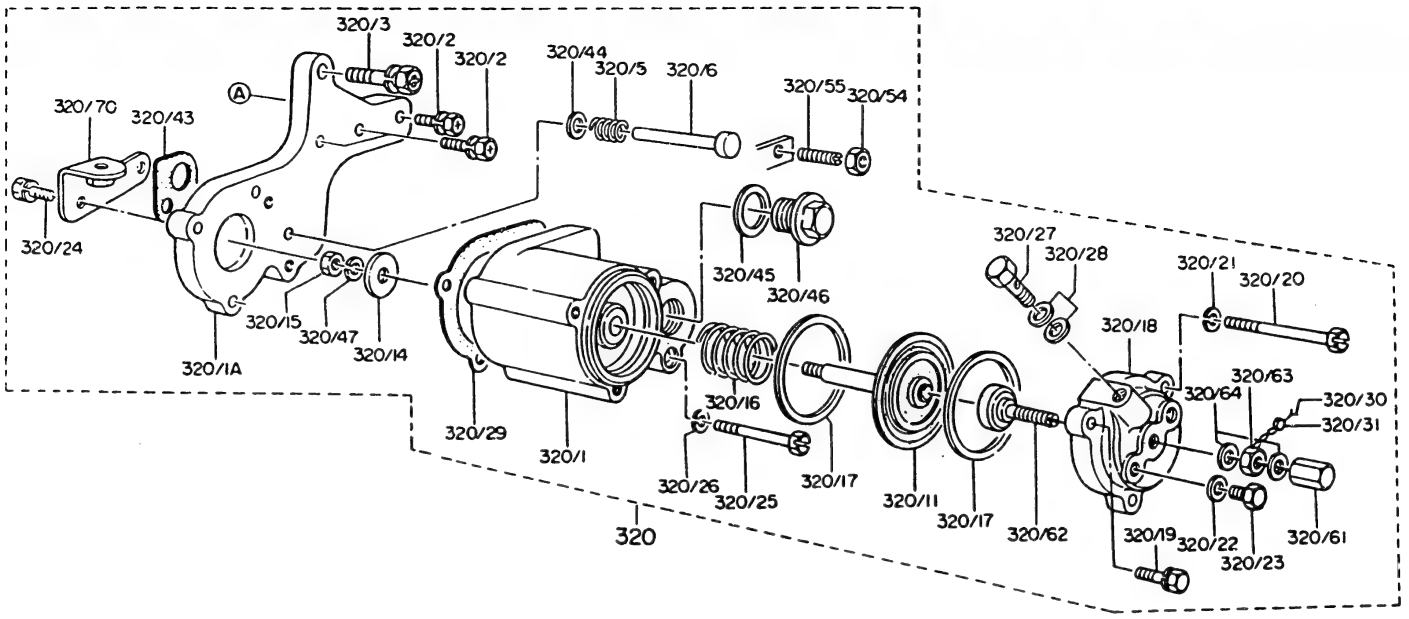


Fig. 201-1

Exploded view of the boost compensator-equipped RLD-A governor (continued)

PART NAMES

1	Governor housing
1/3	Bushing
2	Adaptor
3	Screw
4	Spring eye
5	Bolt
7	O-ring
8	Full-load lever shaft
9	Sensor lever
10	Snap ring
11	Shim
12	Return spring
13	Full-load set lever
14	Spring washer
15	Nut
16	Guide screw
17	U-shaped lever
18	Cancel spring
20	Supporting lever
21	Collar
22	O-ring
23	Shim
24	Return spring
25	Cap
26	Stop lever
27	Bolt
35	Governor cover
35/2	Tension lever shaft
35/3	Plug
35/4 1	Tension lever
35/4 2	Rod
35/4 3	Adjusting nut
35/4/4	Lock screw
35/4/5	Spring, inner
35/4/6	Spring, outer
35/5	Guide lever
35/6	Bushing
35/7	Cancel spring
35/8	Pin
35/9	Snap ring
51	Bolt
65	Rack cap
100	Flyweight assembly
101	Woodruff key
102	Spring washer
103	Round nut
110	Sleeve sub-assembly
111	Adjusting shim
112	Shifter
130	Governor spring, outer
131	Governor spring, inner
132	Start spring
133	Idling spring sub-assembly
135	Lock nut
136	Gasket
137	Cap nut
140	Governor shaft
141	Guide screw
145	Lock nut
146	Lock nut
147	Lock nut
148	Gasket
149	Cap nut
150	Spring seat
155	Rack connecting link
156	Bolt
157	Spring washer
158	Nut
159	Plate
160	Floating lever sub-assembly
160/1	Floating lever
160/2	Snap ring
160/3	Supporting lever
160/4	Snap ring
160/5	Cancel spring
160/6	Control lever shaft
167	Oil seal
168	Adjusting shim
170	Control lever
171	Spring washer
172	Nut
173	Full-load setting bolt
174	Idling-speed setting bolt
175	Maximum-speed setting bolt
176	Lock nut
177	Lock nut
236	Gasket
237	Gasket
250	Bracket
251	Spring
252	Bolt
257	Tube
300	Torque cam
301	Snap ring
303	Snap ring
310	Gasket
311	Plug
320	Boost compensator assembly
320/1	Housing
320/1A	Spacer
320/2	Bolt
320/3	Screw
320/5	Spring
320/6	Push rod
320/11	Diaphragm
320/14	Disk
320/15	Nut
320/16	Spring
320/17	Gasket
320/18	Cover
320/19	Bolt
320/20	Bolt
320/21	Spring washer
320/22	Gasket
320/23	Plug
320/24	Bolt
320/25	Bolt
320/26	Spring washer
320/27	Eye bolt
320/28	Gasket
320/29	Gasket
320/30	Wire
320/31	Lead seal
320/43	Gasket
320/44	Washer
320/45	Gasket

Part names (continued)

320/46	Plug
320/47	Spring washer
320/54	Nut
320/55	Screw
320/61	Cap nut
320/62	Screw
320/63	Nut
320/64	Gasket
320/70	Bracket
400	Bracket
401	Bracket

Four different RLD governor models are available. This section will describe the features of each model.

RLD-A Type

1. This type is mounted on the PE(S)-A type injection pump, and is widely used with small and medium-sized vehicles.

2. This type cannot be used with the PE(S)-AD S injection pump because an injection pump of this type generates intense vibrations during operation, resulting in premature wear of the governor parts.

3. This type cannot be used with special purpose vehicles (e.g. fire engines, cranes etc.), as the speed droop of these vehicles in the medium and high speed ranges is too large.

RLD-B Type

1. This type is an improved version of the RLD-A Type and features superior resistance to wear of the governor parts.

2. This type can be used with the PE(S)-AD fuel injection pump.

RLD-C Type

1. This governor has a smaller speed droop over the medium and high speed ranges than the RLD-A and RLD-B Types.

2. This type can be used with special purpose vehicles as well as with regular vehicles.

RLD-E Type

This governor has been produced with the aim of cost reduction in mind, and is based on a total review of all the components of the present RLD-A type governors, with particular attention paid to standardization of parts and simplification of the adjusting mechanism.

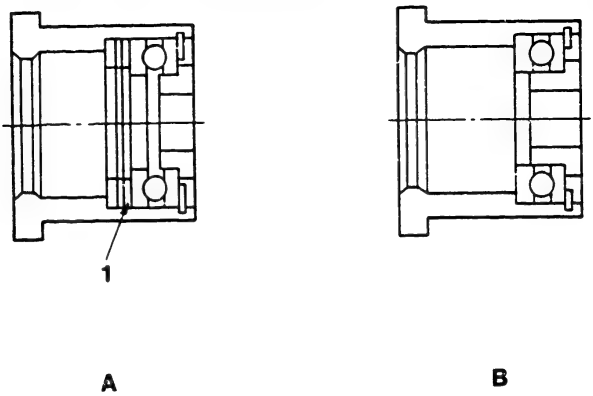


Fig. 202

A = RLD-B type
B = RLD-A type

1 = Rubber damper

Differences between the RLD-A and RLD-B type governors

Details of modification

Normally the pumping action of the fuel injection pump generates vibration which when transmitted to the various parts causes wear. The sleeve has been modified to fit a rubber damper which absorbs vibration from the pump.

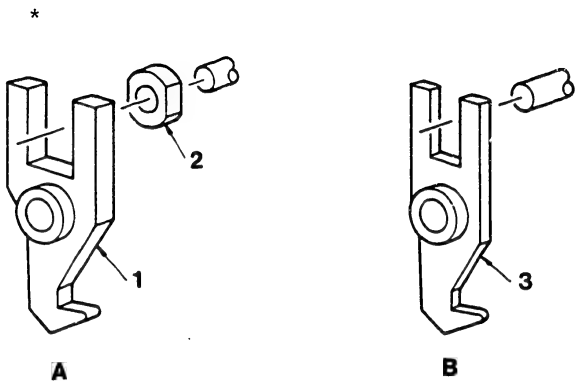


Fig. 203

A = RLD-B type
B = RLD-A type

1 = Sensor lever
2 = Collar
3 = Sensor lever

* Collar added to sensor lever yoke part

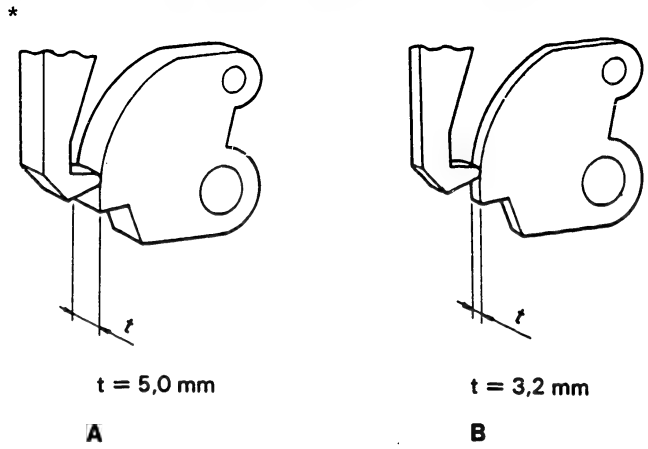


Fig. 204

* Increased width of contact face of torque cam and sensor lever

Differences between the RLD-A and RLD-B type governors

Details of modification

As a result of wear of various parts of the governor, loosening of these parts occurred, with the control rack shifting in the direction to increase fuel injection quantity. The contact surface pressure of the various parts of the governor has been reduced, aiming at improvement of resistance to wear.

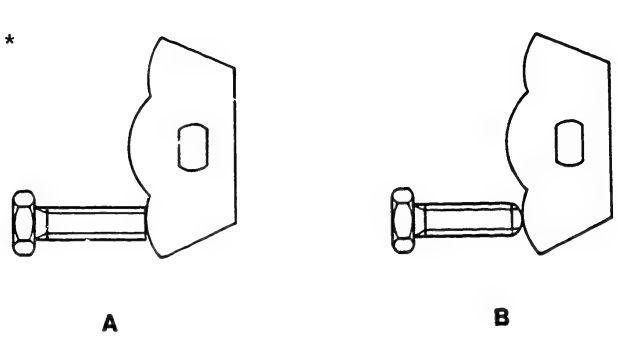


Fig. 205

A = RLD-B type
B = RLD-A type

Differences between the RLD-A and RLD-B type governors

* Tip of full load screw flattened

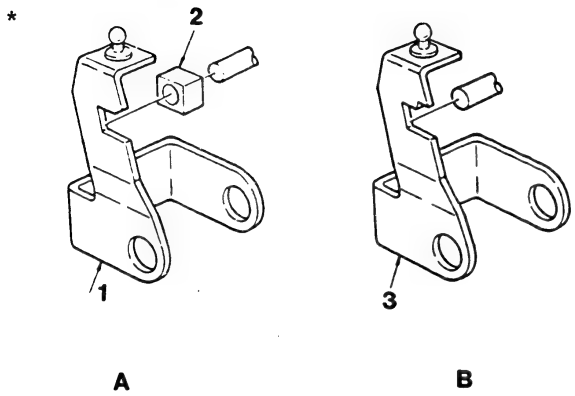


Fig. 206

A = RLD-B type
B = RLD-A type

1 = Guide lever
2 = Collar
3 = Guide lever

* Collar added to notched section of the guide lever

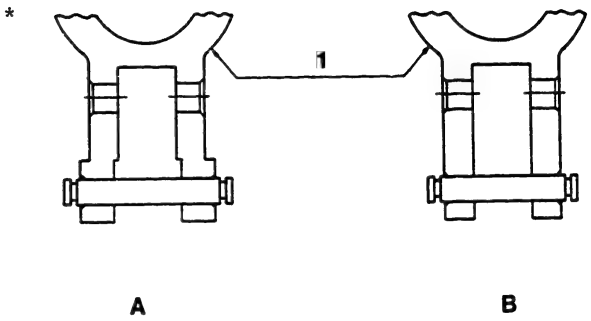


Fig. 207

1 = Tension lever

* Increased face width of the tension lever shifter pin bearing

Differences between the RLD-A and RLD-B type governors

Details of modification

Due to wear of various parts of the governor, loosening of these parts occurred with the control rack shifting in the direction to decrease fuel injection quantity, thereby reducing the engine speed.

The contact surface pressure of various parts of the governor has been decreased, aiming at improving resistance to wear.

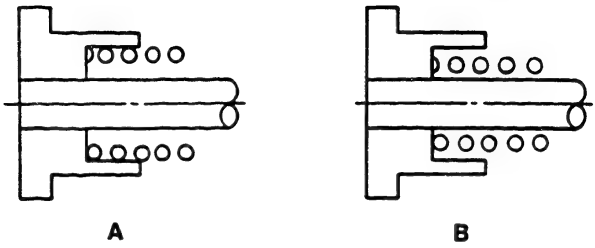


Fig. 208

A = RLD-B type
B = RLD-A type

Differences between the RLD-A and RLD-B type governors

Details of modification

Governor spring (inner) inside diameter increased to prevent interference with governor shaft.

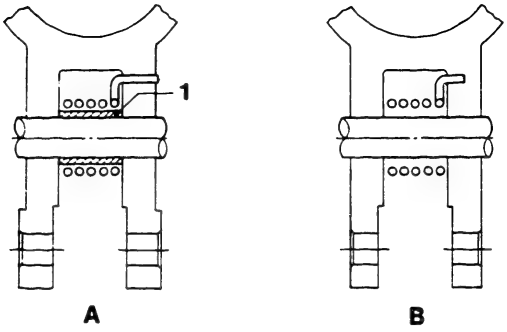


Fig. 209

A = RLD-B type
B = RLD-A type

1 = Collar

Differences between the RLD-A and RLD-B type governors

* Flyweight pin diameter modified.
  Pin diameter: 9 Ø - 7 Ø

Details of modification

A collar has been added to the tension lever shaft to prevent interference with the cancel spring.

Cancel spring hook length has been increased to assure a secure connection.

Improved resistance to wear of flyweight.

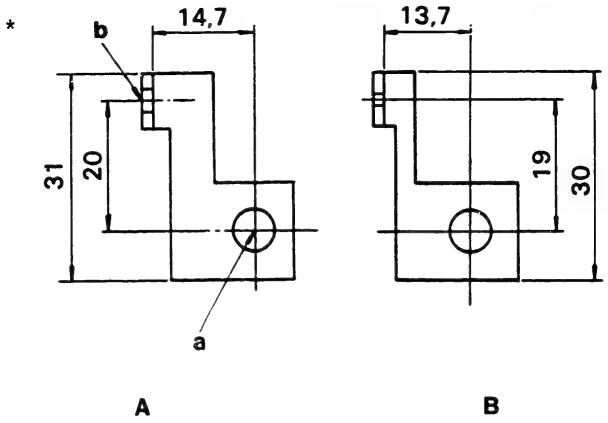


Fig. 210 * Alteration of the start spring hook hole position

A = RLD-C type
B = RLD-A (B) type
a = Fitting bolt hole
b = Start spring hook hole

Differences between the RLD-A (or B) and RLD-C type governors

In order to improve the speed droop in the medium and high speed ranges, the C-model flyweight shape has been changed and dimensions have been enlarged. As a result the governor cover and governor housing shape have been modified (enlarged).

Continuation

Details of modification

In conjunction with modification of the shape of the flyweight, prevention of interference inside the governor has also been accomplished by altering the start spring hook hole position.

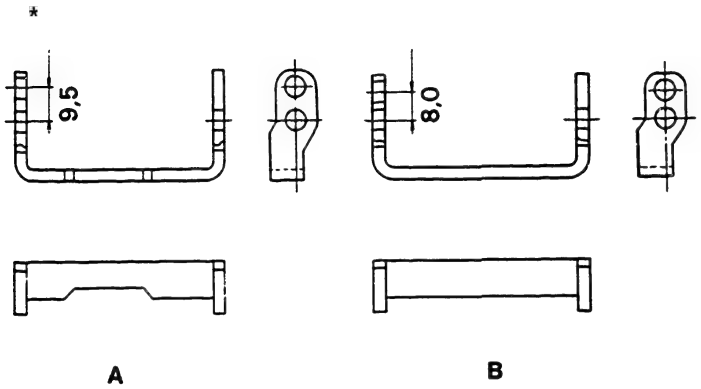


Fig. 211

A = RLD-C type
B = RLD-A (B) type

* Modification of the shape of the U-shaped lever

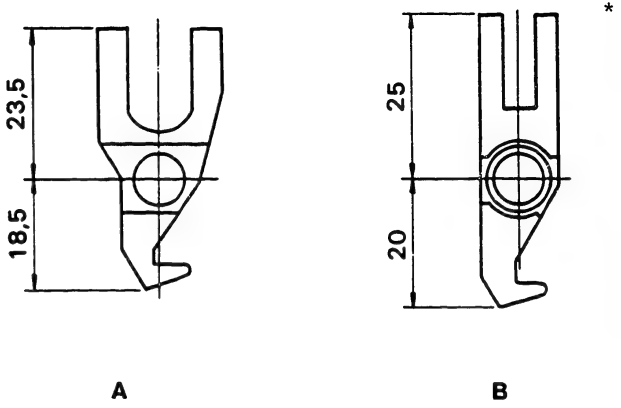


Fig. 212

* Modification of the fulcrum and shape of the sensor lever

Differences between the RLD-A (or B) and RLD-C type governors

Details of modification

In conjunction with modification of the shape of the flyweight, prevention of interference inside the governor has also been accomplished by altering the start spring hook hole position.

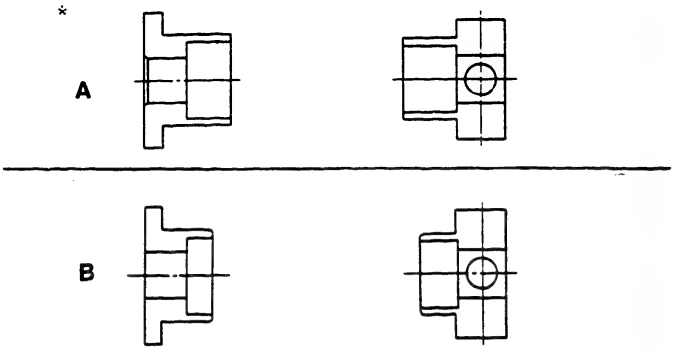


Fig. 213 * Shape of spring seat modified

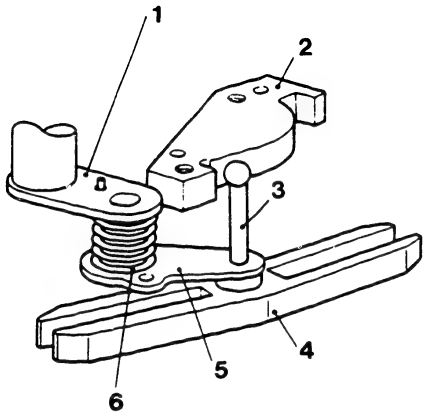
A = RLD-C type
B = RLD-A (B) type

Differences between the RLD-A (or B) and RLD-C type governors

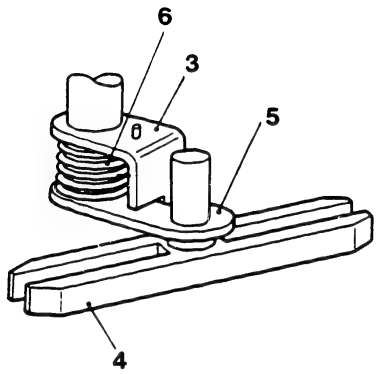
Details of modification

The spring seat guide has been extended to assure a secure connection.

*



A



B

Fig. 214

1 = No. 1 supporting lever
2 = Cam plate
3 = Pin
4 = Floating lever
5 = No. 2 supporting lever
6 = Cancel spring (2)

A = RLD-C type
B = RLD-A (B) type

3 = L-shaped lever
4 = Floating lever
5 = Supporting lever
6 = Cancel spring (2)

Differences between the RLD-A (or B) and RLD-C type governors

Flyweight lift changed from 13 mm to 15 mm

* Cam plate installed in the top of the governor cover, and supporting lever shape modified

Details of modification

Improved speed droop in the medium and high speed ranges.

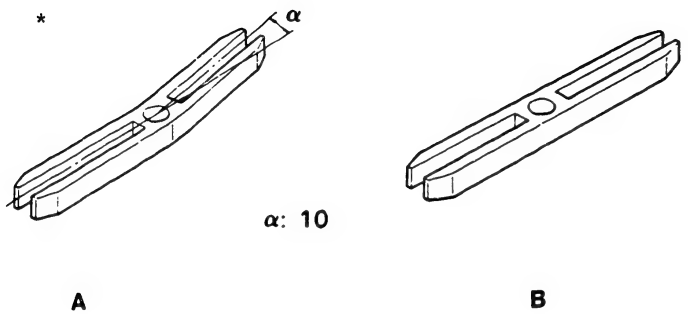


Fig. 215 A = RLD-C type
B = RLD-A (B) type

Differences between the RLD-A (or B) and RLD-C type governors

* Modified shape of the floating lever

Details of modification

Improved speed droop in the medium and high speed ranges.

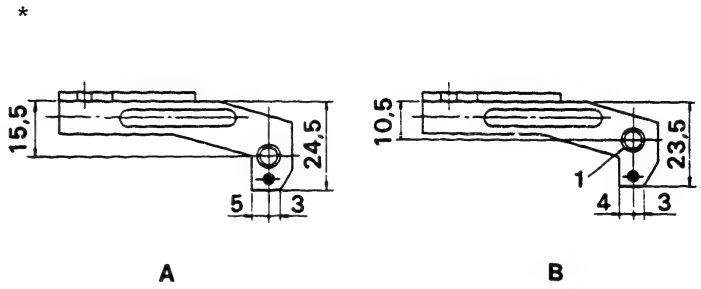


Fig. 216 1 = Ball joint

* Altered position of the rack connecting link ball joint

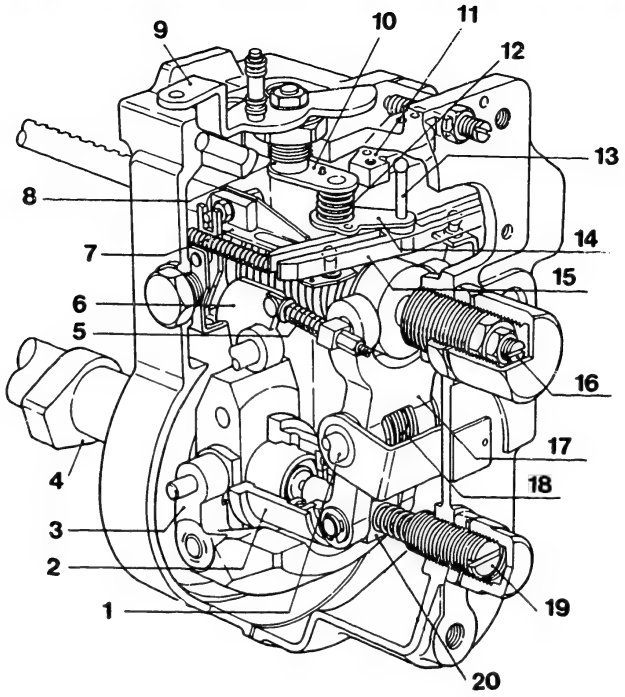


Fig. 217 RLD-C type governor

1 = Tension lever shaft
2 = Sleeve
3 = Flyweight
4 = Camshaft
5 = Rod and spring
6 = Torque cam
7 = Rack connecting link
8 = Control lever shaft
9 = Control lever
10 = No. 1 supporting lever
11 = Cam plate
12 = Cancel spring (2)
13 = Pin
14 = No. 2 supporting lever
15 = Floating lever
16 = Governor shaft
17 = Tension lever
18 = Cancel spring (1)
19 = Idling spring
20 = Shifter

Fig. 217 shows the construction of the RLD-C type mechanical governor.

Basically, the RLD-C type mechanical governor is of the same construction as the RLD-A type governor. In order to improve the speed droop in the medium and high speed ranges, a cam plate has been installed in the top of the governor cover and the supporting lever mechanism changed to the twin type.

The No. 1 supporting lever is press-fitted into the control lever shaft.
The No.2 supporting lever (which supports the floating lever)is held by the cancel spring (2). A pin is press-fitted into the No. 2 supporting lever to enable movement along the curved face of the cam plate provided in the top of the governor cover.
(The No. 2 supporting lever is supported so as to rotate counterclockwise from the cancel spring(2)).

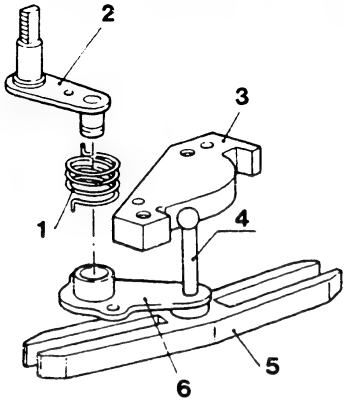


Fig. 218

1 = Cancel spring (2)
2 = No. 1 supporting lever
3 = Cam plate
4 = Pin
5 = Floating lever
6 = No. 2 supporting lever

Thus, by operating the control lever the Nos. 1 and 2 supporting levers will move together, enabling shifting of the floating lever pin. (Fig. 218)

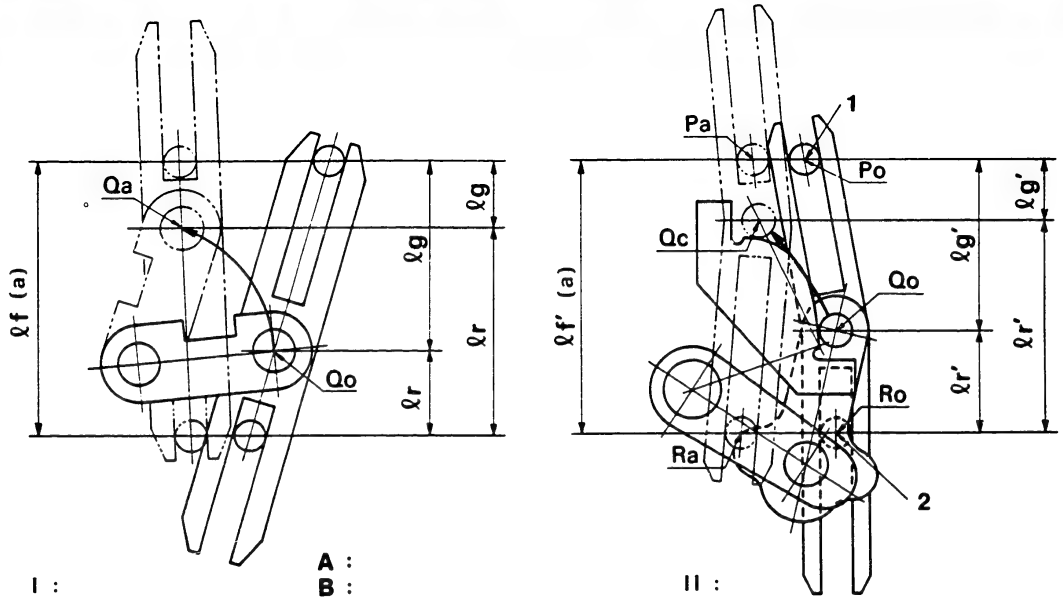


Fig. 219

A: Solid line: At low speed
B: Broken line: At high speed

1 = Guide lever side ball joint
2 = Connecting link side ball joint

I : RLD-A type

(a) fixed

II : RLD-C type

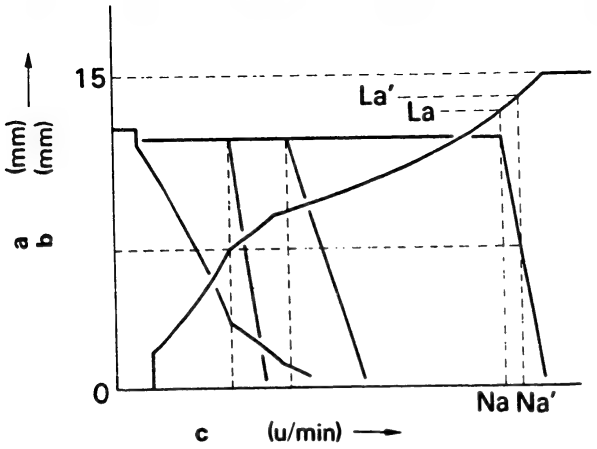
A comparison of the RLD-A and RLD-C governors

The fulcrum of the floating lever in the RLD-A governor is set within a circle with a radius equal to the distance between the two fulcrums of the supporting lever, as shown in Fig. 219-I.

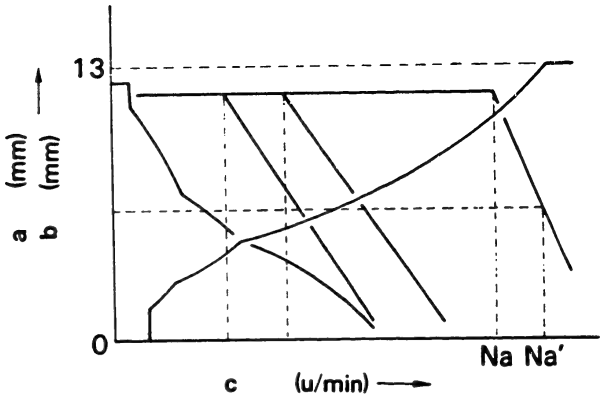
The lever ratio of the floating lever varies from 1 to 4, depending on the lever position. In the RLD-C governor, the pin of No. 2 supporting lever is engaged as it moves along the cam plate. Therefore, the lever ratio of the floating lever changes from 1.3 to 7, depending on the lever position. Furthermore, a governor of this type has a larger flyweight lift than the RLD-A type, and it exhibits improved speed control response (speed control performance).

A comparison of the RLD-A and RLD-C governors

Type	Lever ratio	Total flyweight lift
RLD-A	1.0 to 4.0	13 mm
RLD-C	1.3 to 7.0	15 mm



I:



II:

Fig. 220 Relation between control rack position and flyweight lift in reference to pump speed

a = Control rack position
b = Flyweight lift
c = Pump speed (rpm)

I : RLD-C type

a = Control rack position
b = Flyweight lift
c = Pump speed (rpm)

II : RLD-A type

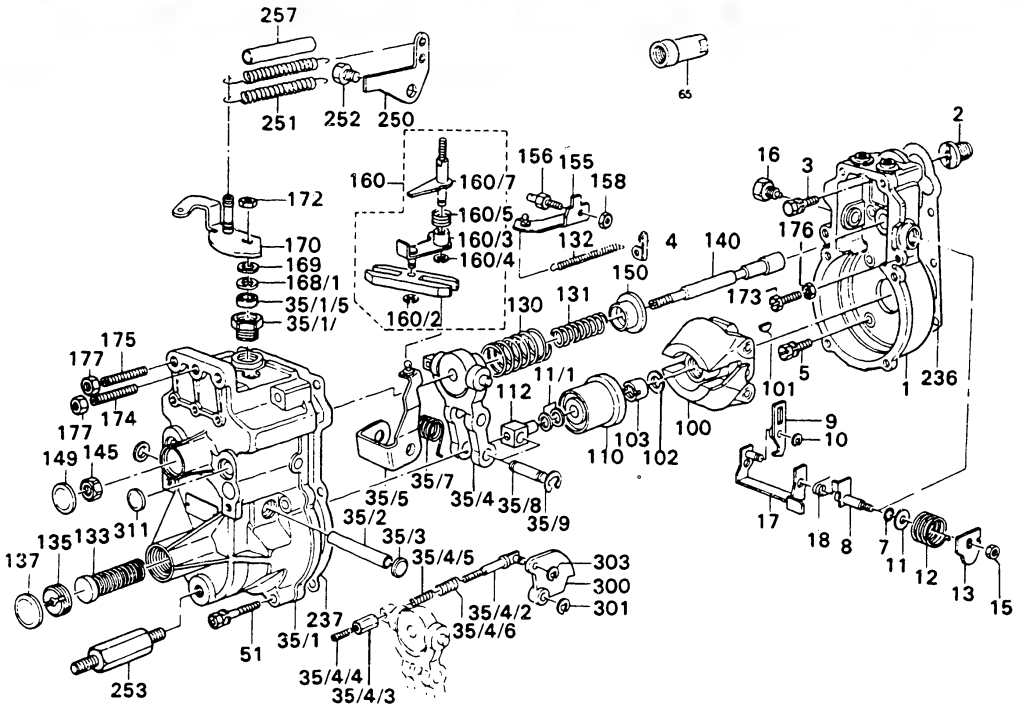
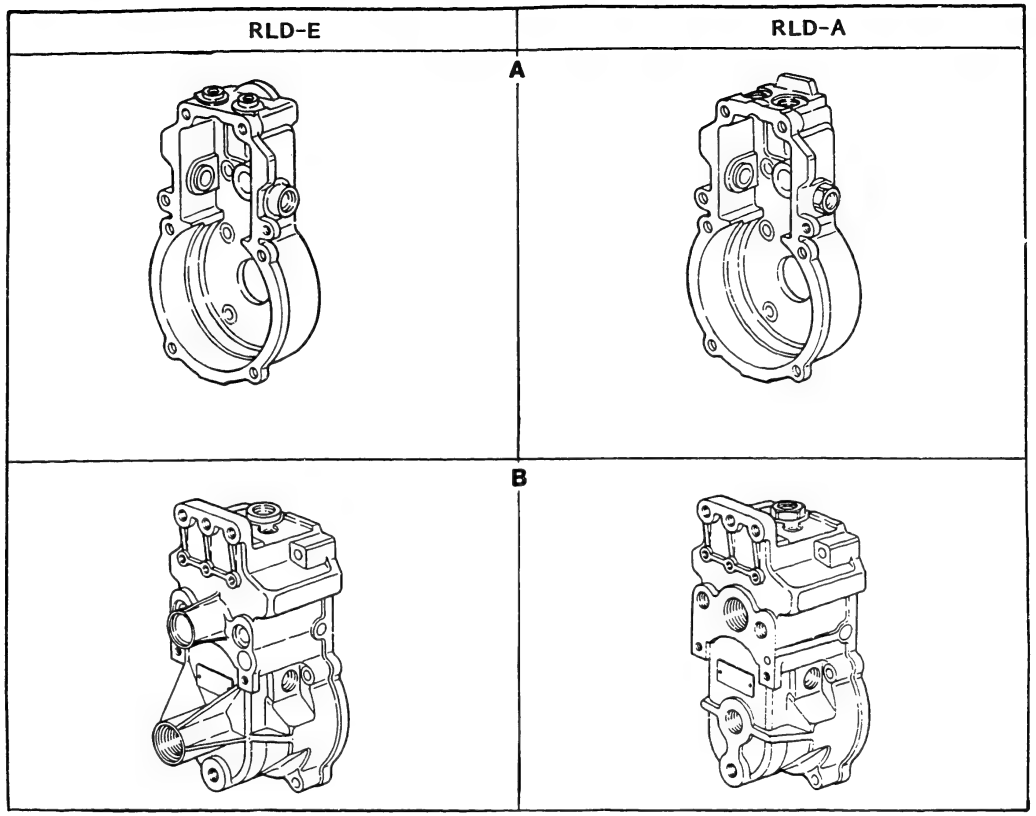


Fig. 221 Exploded view of RLD-E type governor

Differences between the RLD-A and RLD-E type governors

Fig. 221 shows an exploded view of the RLD-E type governor.
Although the construction of the RLD-E type governor is almost identical to that of the RLD-A type governor, it was developed with the purpose of standardizing parts and simplifying adjustment procedures in mind. The parts shown on the following pages differ from those of the RLD-A type governor.



Differences between the RLD-A and RLD-E type governors

Fig. 222 A = Governor housing

Fig. 223 B = Governor cover

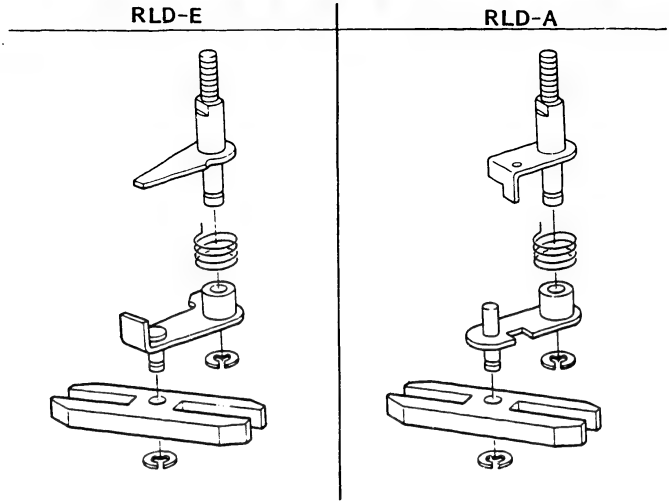
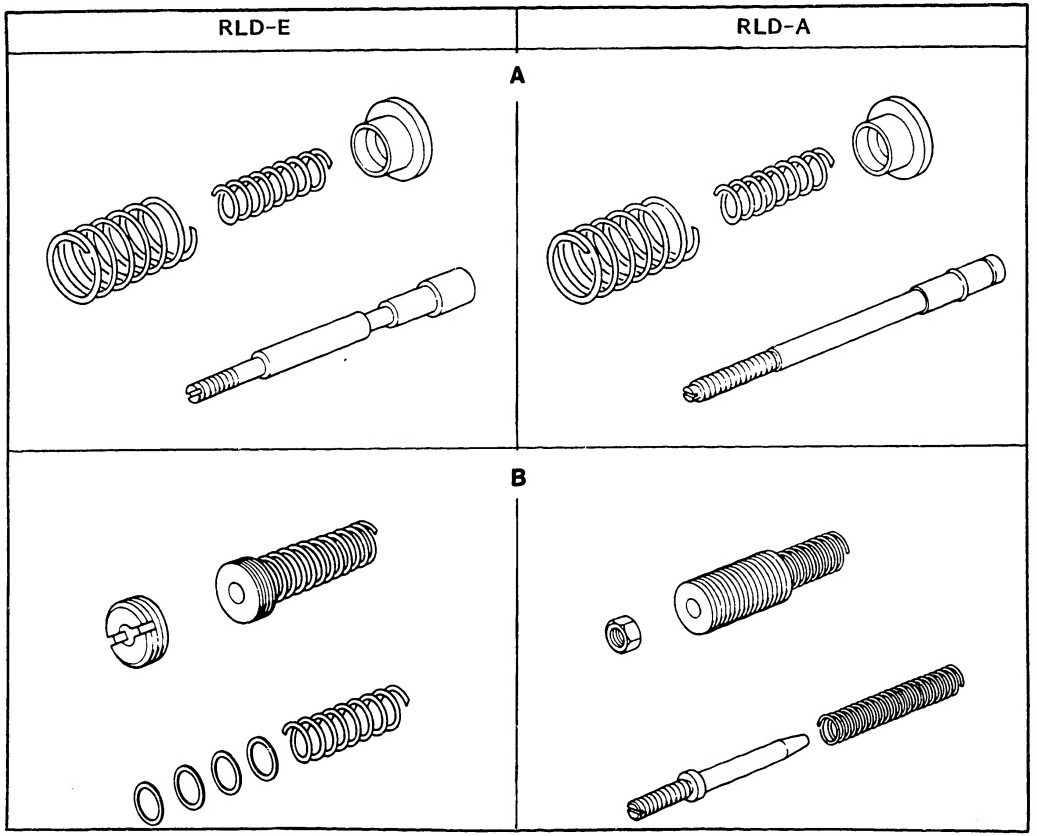


Fig. 224 Control lever shaft and related parts

Differences between the RLD-A and RLD-E type governors



Differences between the RLD-A and RLD-E type governors

Fig. 225 A = Governor shaft, springs and seat

Fig. 226 B = Idling spring assembly

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